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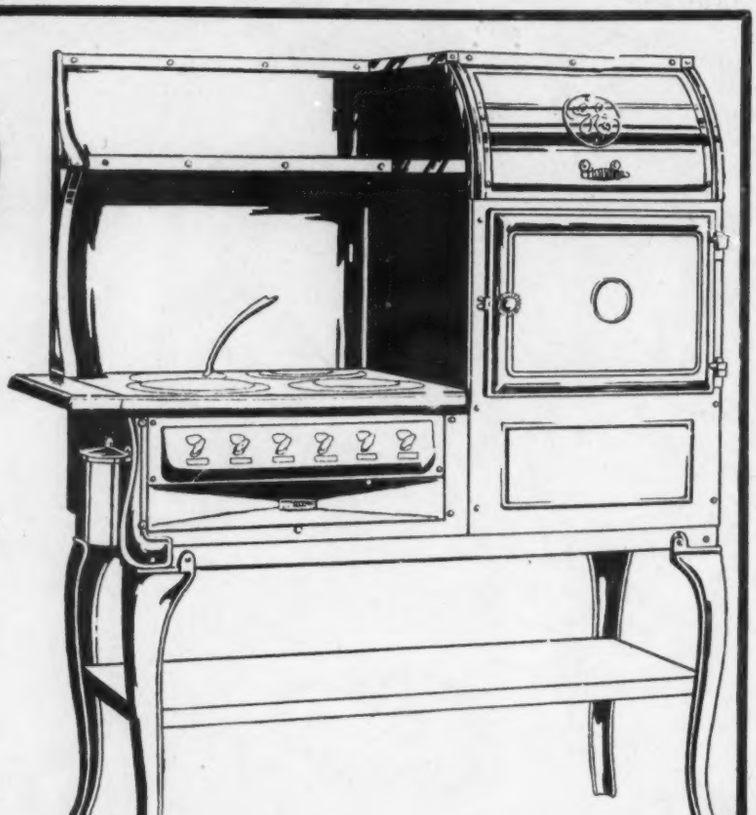

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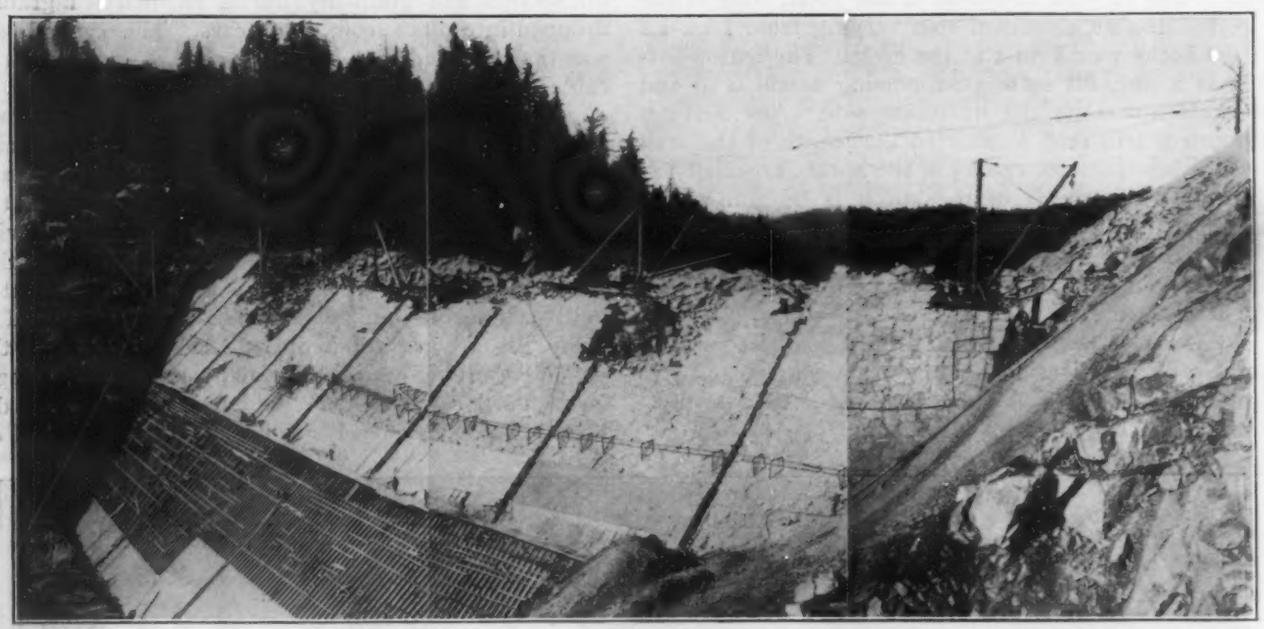
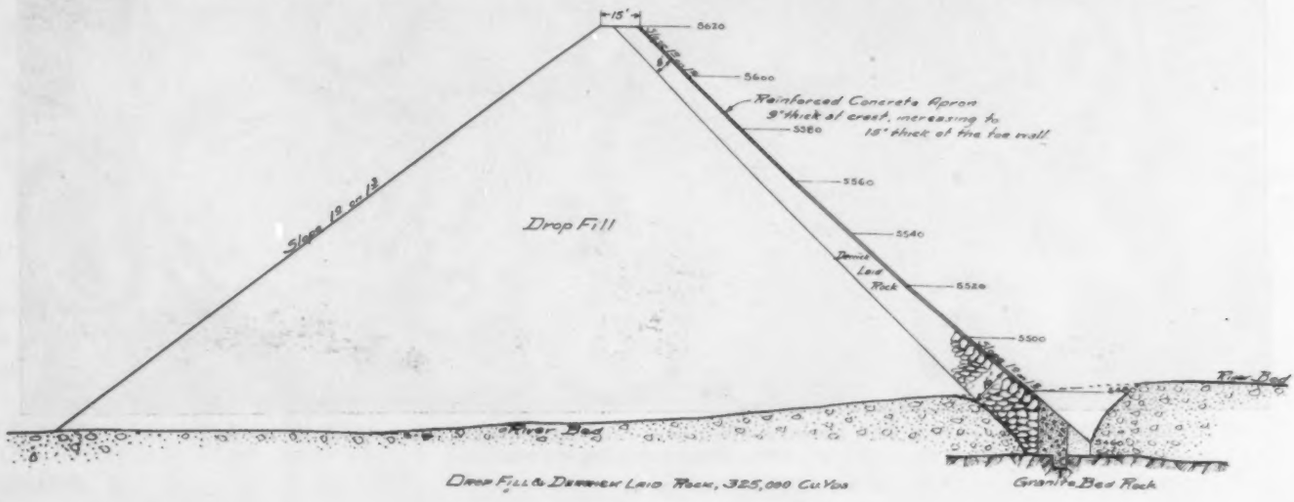
THE STRAWBERRY DROP-FILLED DAM

The second of a series of five great impounding reservoirs constituting the Stanislaus storage system of the Sierra & San Francisco Power Company is a drop-filled granite dam, which has just been completed at Strawberry, 32 miles northeast of Sonora, California, and the same distance from the Hetch Hetchy development, where a similar dam is to be built by the City of San Francisco. The structure is not only noteworthy as the largest of its type in the West, but is also interesting because of the novel construction methods used.

The rock-fill type was selected because of the excellent bed-rock, the fine granite available and the 19-mile haul from the nearest railroad should concrete



Strawberry Dam, Nov. 29, 1915, showing Lower Portion of Concrete Apron and Upper Section of Derrick Laid Section.



Cross Section of Strawberry Dam.

Strawberry Dam, Oct. 1913, showing Old Timber Crib Dam, Excavation for Concrete Toe-wall and Cleared Fill Site.

be used. It takes the place of a log-cut dam built in 1861, whose timbers, by the way, were found to be sound after one-half a century's service.

The dam crest is 620 ft. long, arched upstream with 20 ft. ordinate, and 170 ft. above bed-rock. The dam is 380 ft. wide at the base, and 15 ft. wide at the top, and has an upstream step varying from 1 on 1.2 at the bottom, or 1 on 1 at the crest. The major portion is a drop-fill section supporting a laid wall and concrete apron on the upstream side. Any settling movement will tend to shorten the length of the arch and to close possible cracks in the apron, especially as the upper two-thirds of the apron is built in 60 ft. sections, free to slide on a smooth 3 in. layer of cement mortar. This is made possible by vertical expansion joints, supported by concrete ribs built into the laid section.

After clearing the damsite down to the cemented gravels of the river bed with steam shovel and hydraulic giant, a trench was excavated across the bottom of the canyon to a depth of 33 ft. to bedrock, being filled with concrete to form a toe-wall. Concrete was supplied through wooden flumes leading from mixers on the side hill.

The fill was made in two ways. A trestle was first built across the canyon at about the center of the fill section and gradually buried in quarried granite dropped into place from dump cars. This central row was then covered with rock transported by a system of cable-ways from seven surrounding quarries.

This cable system supported and radiated from a central "spider," each cable acting in the dual capacity of guy line and carrier. A single-line hoist at each quarry raised the loaded bucket from the pit to the cable, and by means of an automatic tripping device then lowered it to the desired place of dumping, this being accomplished by an automatic tripper actuated by a removable bumper on the carrier cable. The empty bucket was then drawn back, lowered to the pit and the cycle repeated—all by means of a single line. The central spider could be moved to any desired position by merely paying out or drawing in on

Strawberry Dam, June 2, 1915, showing Fill-trestle Almost Buried, Cable System in Operation and Derricks laying Rock Face.

any or all of the seven cables. This unique method easily and quickly handled 15 ton loads on 1¼ in. cable, or 800 ft. round trip requiring but two minutes.

Overlaying the fill is a derrick-laid wall of selected stones, weighing from 2 to 5 tons. These stones were carefully set to line by hand and wedged tightly into place. Space was left at 60 ft. parallel intervals for concrete ribs to support the apron. The laid-rock section is 16 ft. at the base and 8 ft. thick at the top.

The reinforced concrete apron is a continuation of the concrete toe wall, forming an impervious layer on the upstream face of the dam. It varies in thickness from 9 in. at the crest to 18 in. at the toe wall. For the lower one-third of the height it is monolithic the upper two-thirds, as already explained, being laid in sections to prevent cracks due to settlement or temperature changes.

This dam provides storage for nearly 18,000 acre feet through a 120 ft. outlet tower discharging into an outlet tunnel excavated through 600 ft. of rock. The outlet tower is of reinforced concrete, 10 ft. outside diameter and 5 ft. inside diameter. It is equipped with six 30 in. gate valves helically spaced at various elevations, these being operated by gate stems on top of the tower. The discharge end of the 5 ft. by 7 ft. tunnel is also equipped with needle valves.

A spillway 100 ft. in length and with lip 8 ft. below the dam crest is provided through solid rock at one side of the dam.

The water is used for both power generation and irrigation. It, together with other developed storage, assures an ample water supply for the 40,000 h. p. plant on the Stanislaus River with its 135 miles of double circuit 104,000 volt lines to San Francisco, as well as for future contemplated developments.

Construction has been carreid on under the direct supervision of H. F. Jackson, vice-president and general manager of the Sierra & San Francisco Power Company, he being represented on the job by the engineering firm of Maloney, Howson & Doane. The contractors were Chadwick & Sykes of San Francisco. M. M. O'Shaughnessy acted as consulting engineer.

STUDY OF HYDROELECTRIC SITES IN CHILE.

By decree of July 1, 1916 (Ministry of Industry and Public Works), an honorary commission was appointed to make a study of the water power available in Chile for the purpose of hydroelectric development. The committee named is as follows: Senor Arturo E. Salazar, Senor Rafael Edwards S., Senor Horacio Valdes C., and Senor Abraham Guzman B. The addresses of the above-named gentlemen are: Escuela de Ingenieria de la Universidad de Chile, Santiago; Calle Agustinas, 1170, Santiago; Chacra Subercaseaux, Santiago; and Calle Bandera, 198, Santiago, respectively. The local press, in commenting approvingly on the appointment of a committee for the above purpose, quote the estimate of Prof. Don Arturo E. Salazar, of the University of Chile, that proper hydroelectric development in Chile would reduce the cost of electricity for the small consumer for commercial purposes from the present price of 70 centavos gold ($0.255 United States currency) to 3 centavos gold ($0.01095).

FUNDAMENTALS OF CLAIM DEPARTMENT WORK.

BY B. F. BOYNTON.

(This interesting discussion of departmental work in a claim office of a public utility company was delivered before the Pacific Claim Agents' Association Convention which met in Tacoma August 9 and 10. The author is in charge of the claim department for the Portland Railway, Light & Power Company.—The Editor.)

The fundamentals of Claim Department work, summed up, are efficiency, co-operation, courtesy, prevention of accidents, and fair, square dealings, both with the public and the company you represent.

To accomplish this, you must have competent, trustworthy investigators who will at all times when taking statements from witnesses or claimants, bring out the points, without bias, that are so necessary to the man in charge in determining the liability.

The office force that handles your records and do your filing should be selected as to their especial adaptation for correct filing and keen discernment, for with a corps of wide-awake office help a repeater or fraudulent claimant will very seldom pass through the hands of all without recognition.

The physicians and surgeons who represent a claim department should be big, broad, intelligent men —men who are judges of human nature—for the kind, courteous, considerate attention given a patient by the physician many, many times minimizes what might have been a bad claim to adjust. One of the most potent factors relative to the connection of the physicians with the claim department, should be a thorough understanding between the two, that the physicians should at all times in their reports to the claim department show the injuries up in said reports in such a way that the claim agent will know the exact extent of same.

The attorneys that try the cases for the claim department, should at all times, when dealing with the juries and witnesses, show a disposition to be absolutely fair and impartial; in other words, they should, in their connection with the work in trying cases show to the community at large that all the company which they represent seeks is absolute justice, let it hit where it may.

The prevention of accidents in connection with an electric railway is a very essential fundamental, and I think should be under the claim agent's supervision, as he is in a better position than anyone else to see what is causing different types of accidents, and if he is a man who has had any practical railroad experience, will have a good idea of what would be the best preventive.

Another important fundamental is co-operation between the claim department and the operating department; in fact, to obtain the best results, a claim department must have the hearty co-operation of each and every department connected with the utility company.

Again, I think a claim agent, himself, should not crawl into his "shell and hibernate" but that he should meet with the business men and people at large at their different gatherings and functions and show to the people that he takes an interest in the welfare of the community in which he lives in all its different phases,

willing at all times, if necessary, to give his time toward different public enterprises.

Lastly, I think that the different members of a claim department should be thoroughly schooled in treating the public in a kind, courteous manner, as a "kind word often turneth away wrath." There is nothing that any department in any large or small institution can do that brings about as good results as the practice of being polite and obliging. Members of a claim department should frequently hold meetings and exchange ideas on the best means of obtaining a higher standard of efficiency.

This is a subject that a man could go into and write on at great length, but I feel in the above that the principal fundamentals are covered.

CONCESSION FOR WATER POWER IN PERU.

The government of Peru has granted to the Hydroelectric Company, of the Canon del Pato, a concession for water power in the River Santa to be used for industrial purposes. The concession as published in El Peruano of July 12 grants water rights of 45,000 liters per second in a section of the river 500 meters above the confluence of the Santa with the Colcas for a distance of 25 kilometers, following the course of the River Santa. This water is conceded for manufacturing, and may not be used for any other purpose. Definite plans covering the utilization of the water must be presented before December 1 of next year, and the work must be completed within three years from that date.

IMPEDANCES OF IRON AND STEEL WIRE.

BY CLEM A. COPELAND.

(Herein are given a complete set of curves showing ratios of a.c. and d.c. resistances and inductances for iron and steel telephone wire, of Nos. 4-14, at various current densities. The values found from the curves can then be substituted in the simple formula already developed and from this the impedance in ohms due to skin effect can be readily calculated.—The Editor.)

Finally from all available sources the 12 curves of Figs. 13 to 26 have been prepared for 50 and 60 cycles, giving values of K_R and K_L, based on a straight line relation between the maximum value of K_R and K_L and the area of the wire. Here again theoretical considerations fail as from the argument in formula (3),

$$\varkappa = \frac{2\pi r_1}{.3937}\sqrt{\frac{2\mu f}{10^9 \rho}},$$

(which is proportional to the superficial area) one would expect K_R maximum, to be a function of the diameter of the wire. For very large single wires, say No. 3 B. W. G. and larger, this latter relation may hold.

Some interesting practical considerations are derived from these curves.

Table VII.

	E. B. B. $R_{dc} = 1.099$ (1000′)		Steel $R_{dc} = 1,519$ (1000′)		E. H. S. Steel $R_{dc} = 2.339$ (1000′)	
Amp.	K_R	R_{ac}	K_R	R_{ac}	K_R	R_{ac}
2	1.41	1.55	1.132	1.57	1.005	2.35
4	1.96	2.16	1.247	1.89	1.05	2.46
5	2.488	2.74	1.400	2.12	1.12	2.62
8	2.88	3.17	1.573	2.39	1.195	2.79
10	3.11	3.42	1.785	2.71	1.255	2.94
12	3.20	3.52	2.015	3.06	1.30	3.04
16	3.108	3.42	2.32	3.52	1.335	3.12
22	2.84	3.12	2.275	3.46	1.345	3.15
28	2.64	2.90	2.195	3.33	1.32	3.09
36	2.44	2.68	2.127	3.24	1.29	3.03

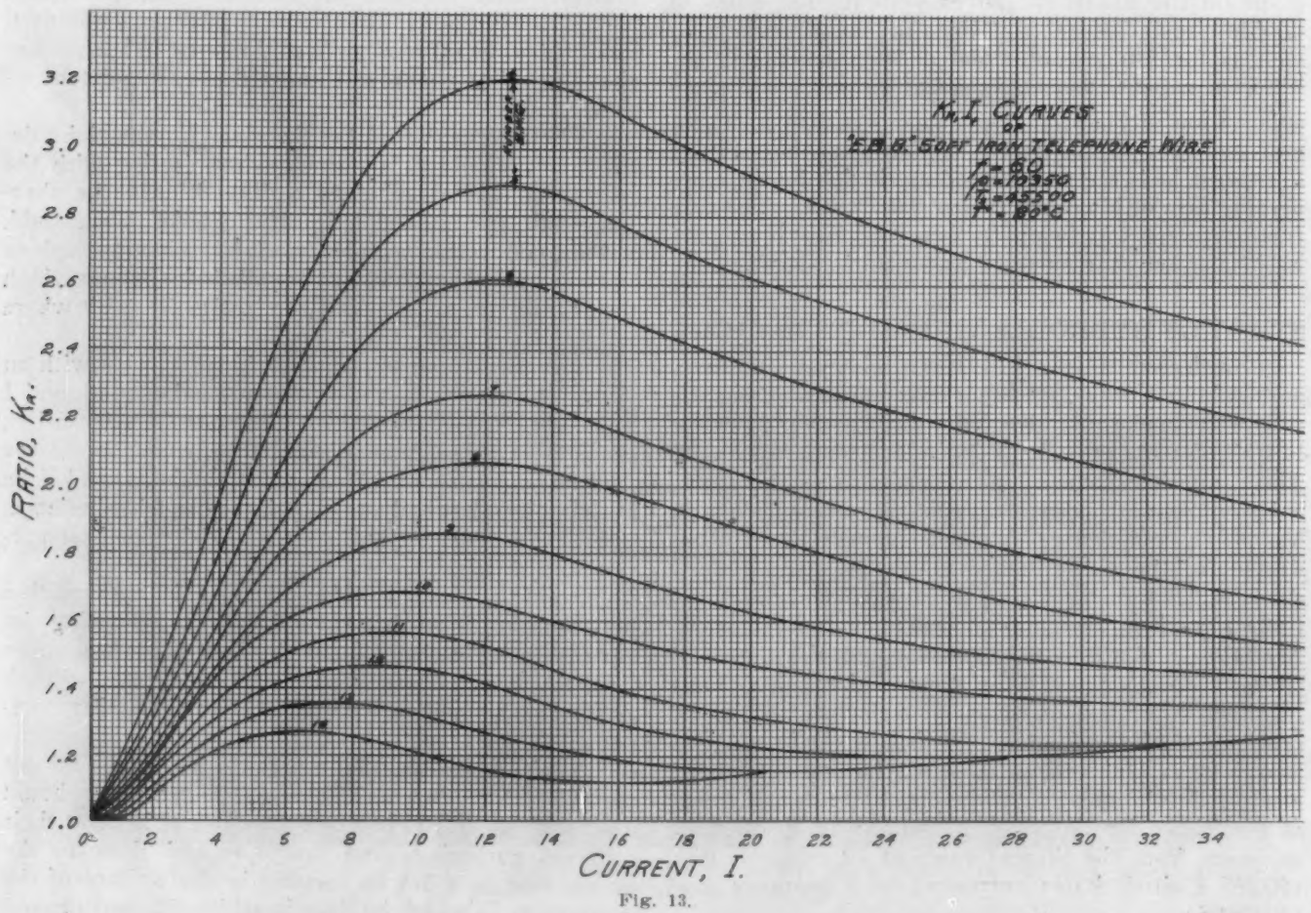


Fig. 13.

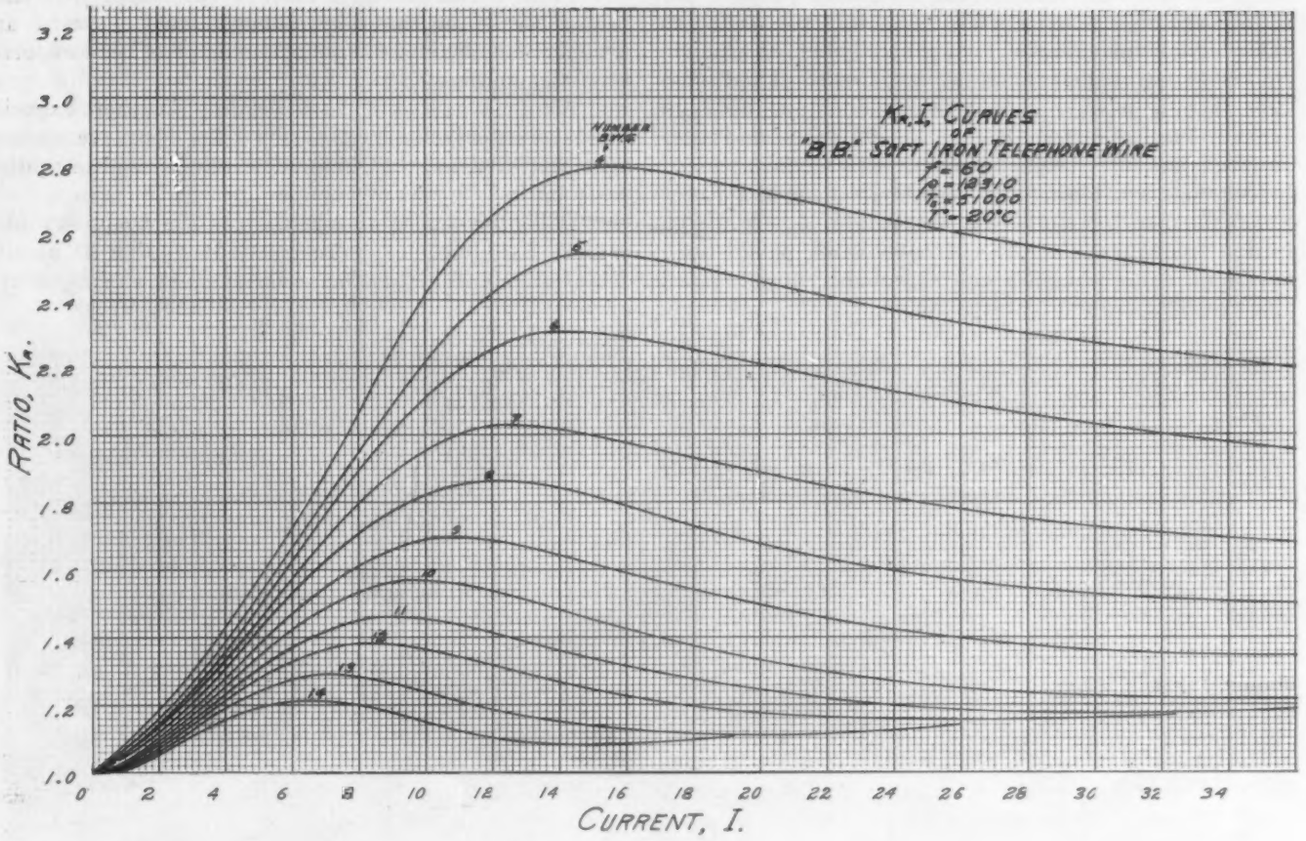

Kn. I. Curves
of
"B. B." Soft Iron Telephone Wire
f = 60
ρ = 12910
μ₀ = 51000
T = 20°C
Number of Wire
Ratio, Kn.
Current, I.

Fig. 14.

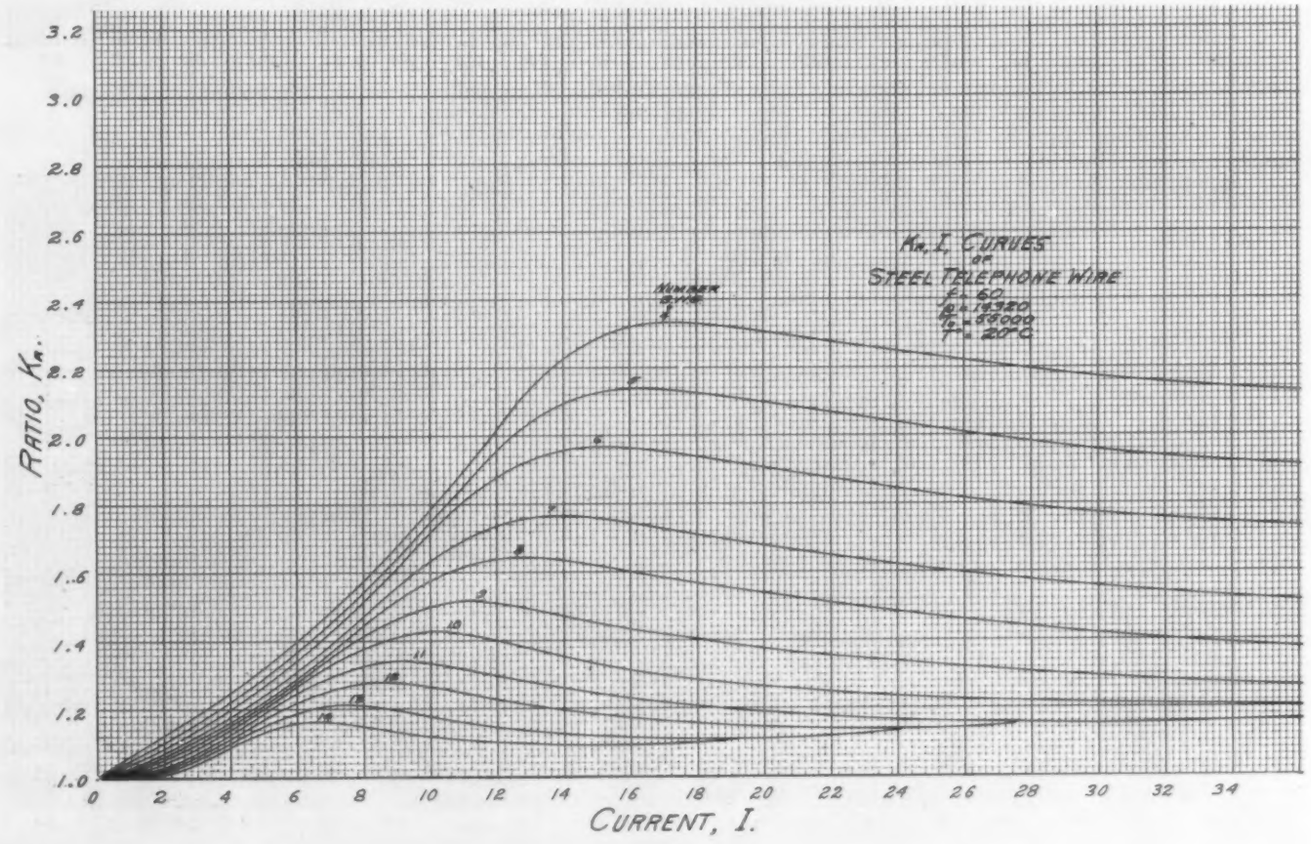

Kn. I. Curves
of
Steel Telephone Wire
f = 60
ρ = 14320
μ₀ = 55000
T = 20°C
Number of Wire
Ratio, Kn.
Current, I.

Fig. 15.

For instance, take No. 4 wire and prepare the following table at 60 cycles. The last two columns are of doubtful value.

It is unfortunate that no experimental data except, as given in Fig 8, are available on the high tension steels of from 80,000 to 250,000 pounds per square inch. The table, however, shows a fact noticed before that the higher the tensile strength the lower the resistance to alternating currents of power distribution frequencies, at the currents which would ordinarily be employed. This fact probably holds for all sizes of wire from No. 14 to No. 4.

From these curves it may be calculated that the power factor of the line remains very constant at all values of the current; a fact which has been experimentally verified.

Another apparent fact needing further experimental confirmation is that the (K_z, I) curve varies very slightly as the frequency varies within quite wide limits.

It has also been shown that as the frequency increases L_{iae} becomes more constant so that at about 3000 cycles and higher K_L = about 20 at all frequency currents, sizes and kinds of iron and steel wires.

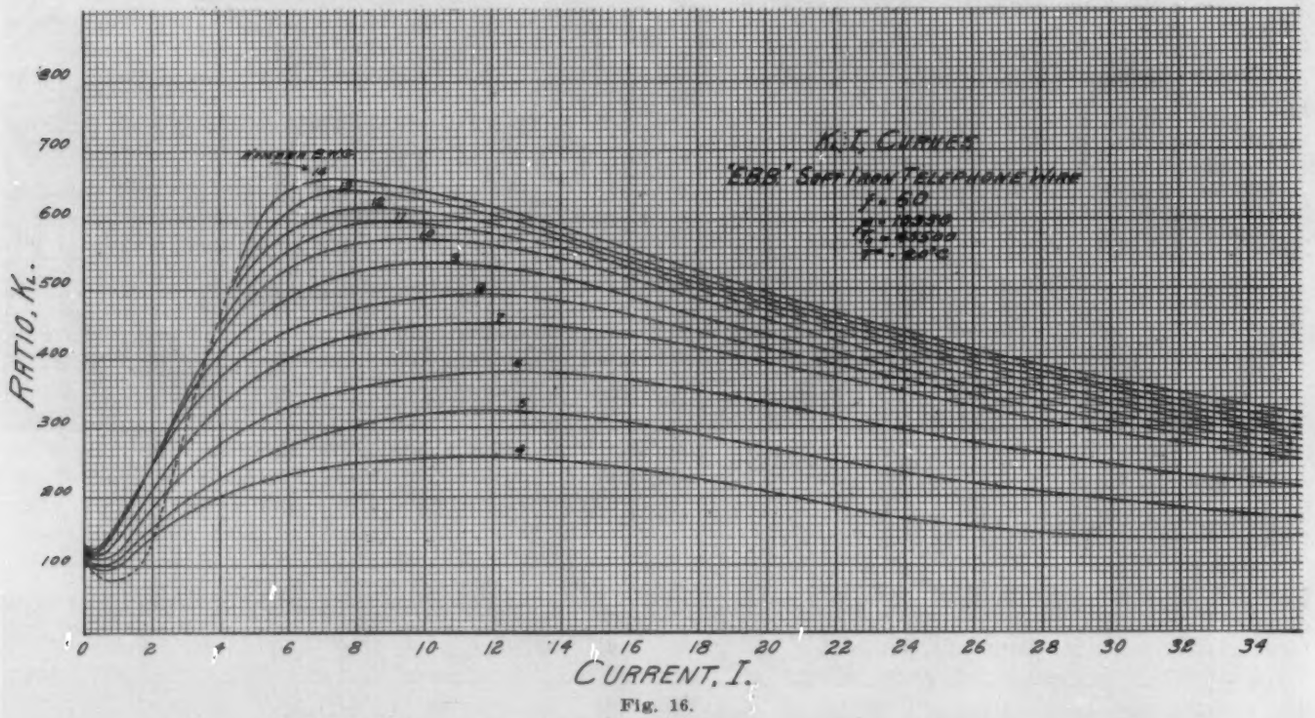


Fig. 16.

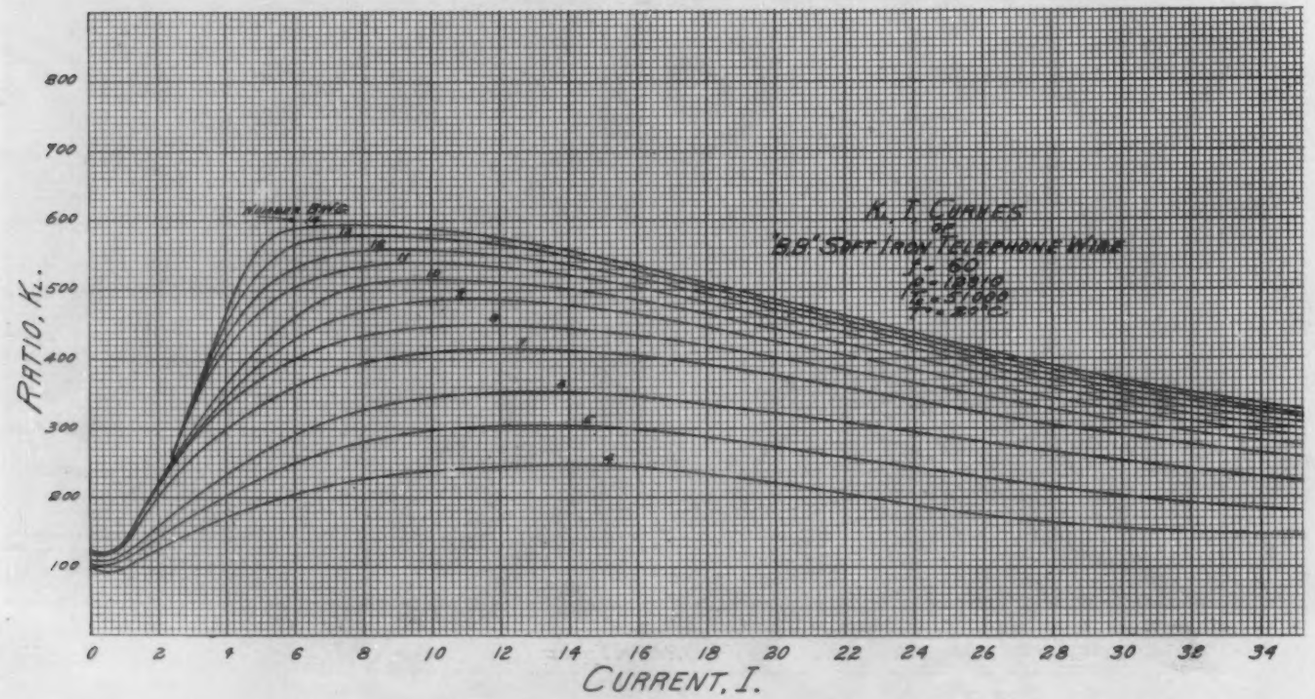


Fig. 17.

This condition is closely approached at 500 cycles.

Two important facts militate against the use of iron wire in the place of copper. At low currents the regulation is poor, due to the large variation in K_R for a small variation of current. It would scarcely be economical to use the higher currents where the regulation is good. Furthermore, the curves show that in the case of a short on the line the resistance rises, thus limiting the current to such a value that protective devices would not operate so that the short might be sustained sometime, the current being high enough to take the temper out of the wire. This trouble has actually occurred. Fortunately in the case of steels of above 80000 pounds tensile strength and especially in cables this danger is not so great.

Problem.—The smallest advisable size of E. B. B. iron wire for cross country small power transmission at 60000 volts and 60 cycles is taken as No. 9 B. W. G.

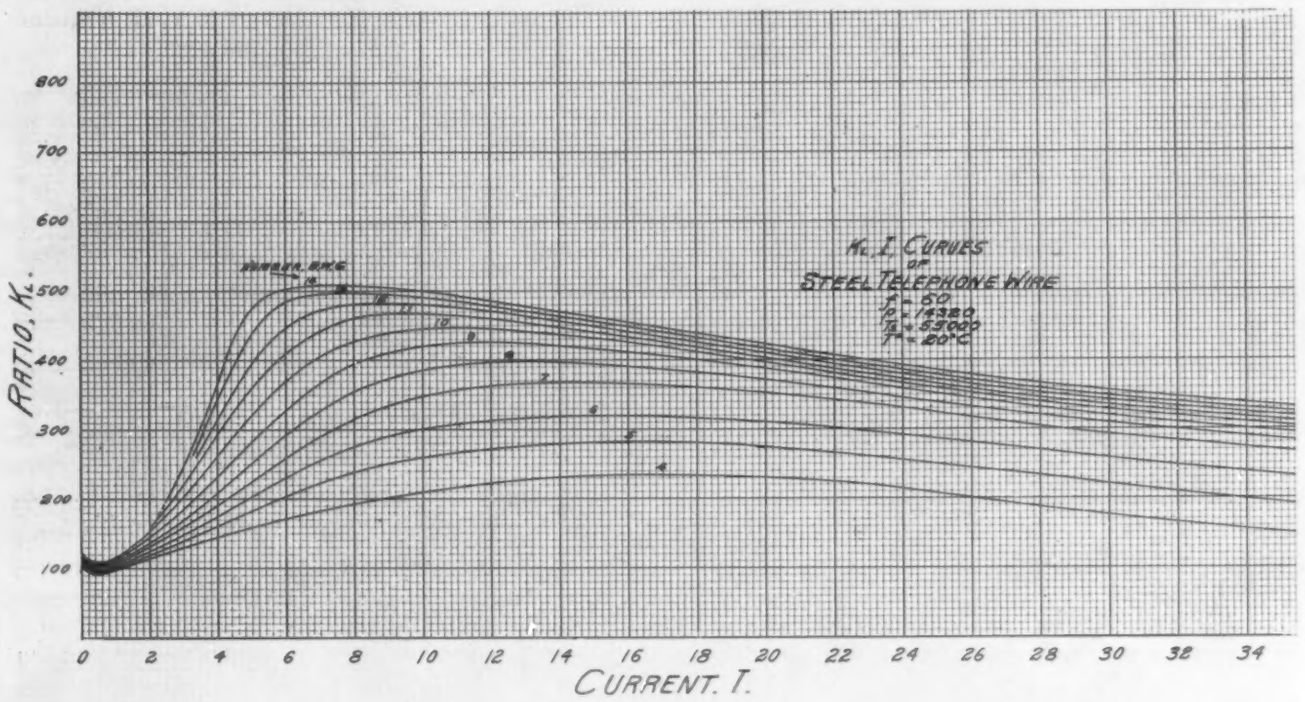


Fig. 18.

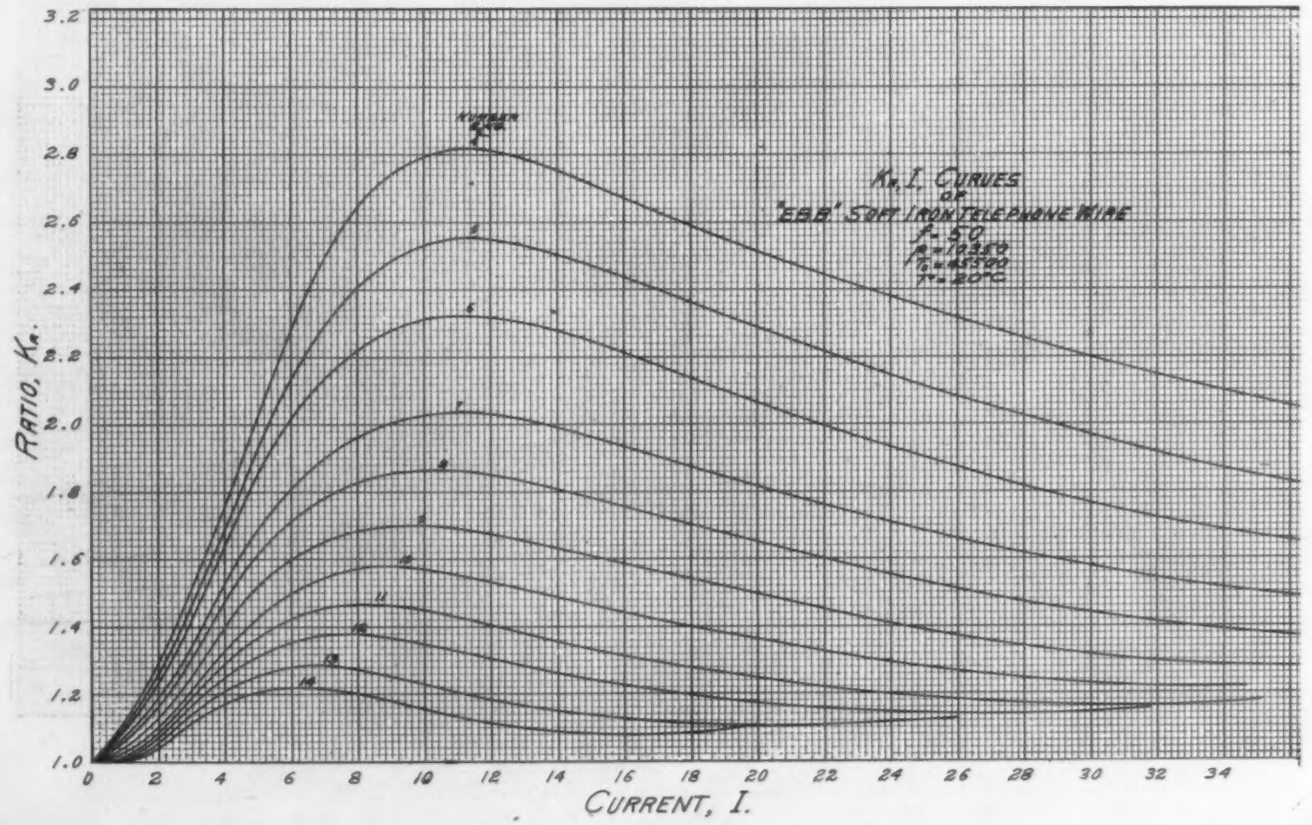


Fig. 19.

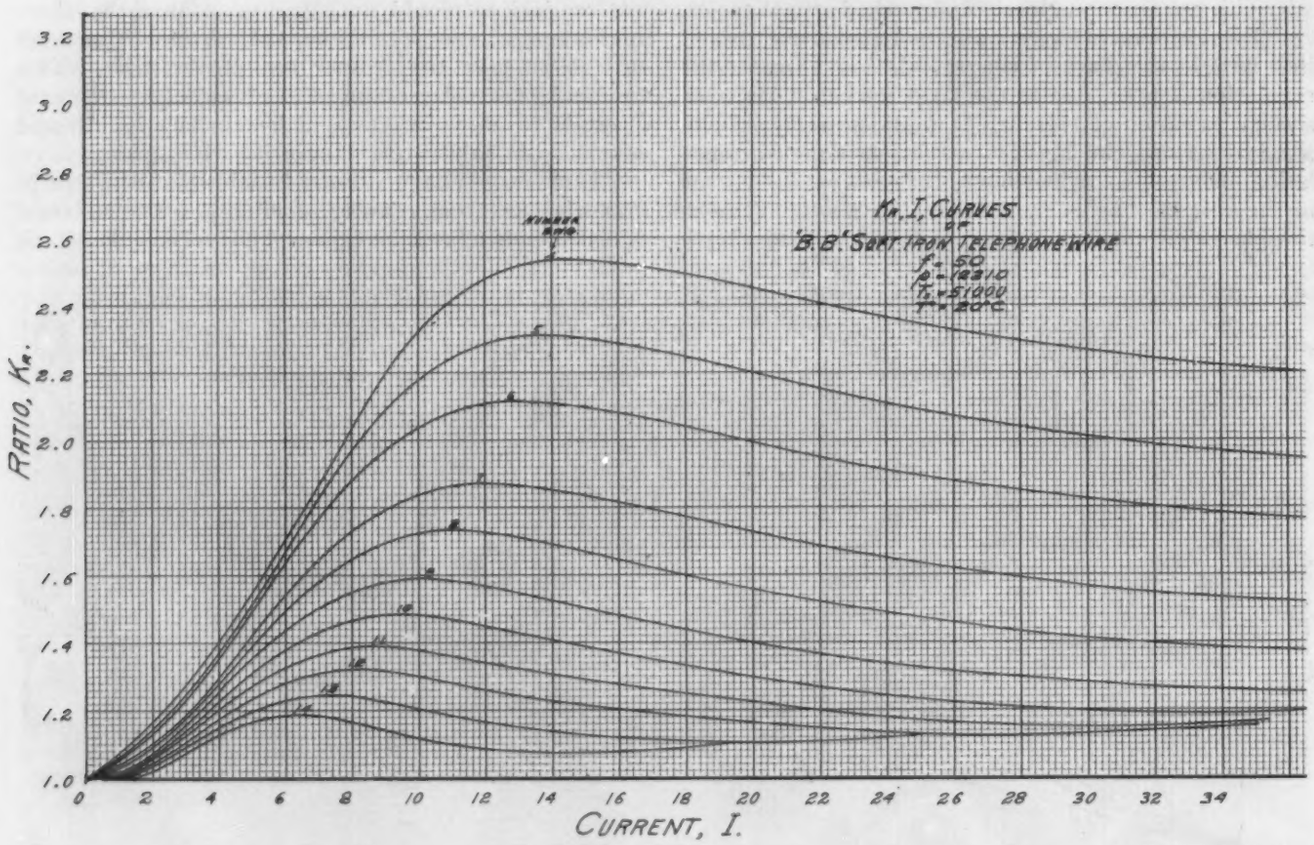

Kn, I. Curves
of
'B.B.' Spot Iron Telephone Wire
f = 60
ρ = 10310
μ = 51000
T = 20°C
Number
Coils
RATIO, Kn.
CURRENT, I.

Fig. 20.

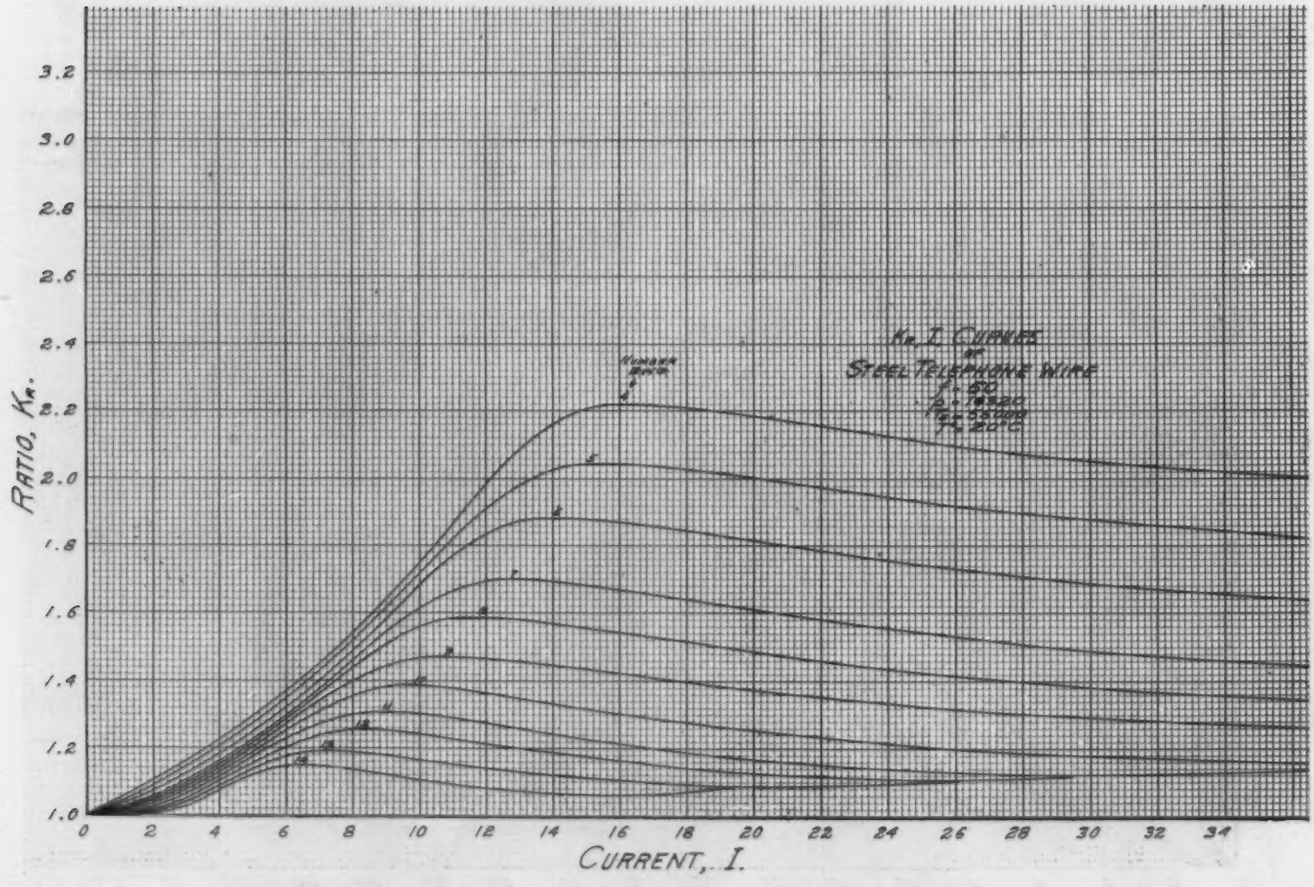

Kn, I. Curves
of
Steel Telephone Wire
f = 60
ρ = 10320
Permeability
T = 20°C
Number
Coils
RATIO, Kn.
CURRENT, I.

Fig. 21.

At a distance of 10 miles, 366 kw. is to be delivered at 88 per cent power factor. The characteristics of the line are desired, the spacing being 74".

Current, $\mathbf{I} = 366{,}000/60{,}000\ \sqrt{3} \times .88 = 4$ amperes.

From the curves, for E. B. B. wire Figs. 13 and 16 $\mathbf{K_R} = 1.473$ and $\mathbf{K_L} = 406$.

$\mathbf{R_{dc}}$ from Table VI is 2.833.

$$\mathbf{Z_{ac}} = \sqrt{(1.473 \times 2.833)^2 + 4\pi^2 60^2 \left(406 \frac{15.24}{10^6} + \frac{140.4}{10^6} \log_{10} \frac{74}{.074}\right)^2}$$

$= 4.865$ ohms per 1000′ of each wire.

$\mathbf{I^2 R_{ac}}$ loss in the line $= 1059$ watts.

THE INTERNATIONAL SYSTEM OF ELECTRIC AND MAGNETIC UNITS.

All electrical measurements are based on certain standards kept at the National Bureaus of Standards. These standards represent the units, such as the volt and ampere, in terms of which measurements are expressed. A number of different systems of electric and magnetic units have been proposed from time to time. These systems have been put forward as having noteworthy advantages in a theoretical way over the units which are ordinarily used. A careful study has shown that the advantages of the proposed systems are not such as to justify a general change of units. In fact, the ordinary units are in many ways superior to those proposed.

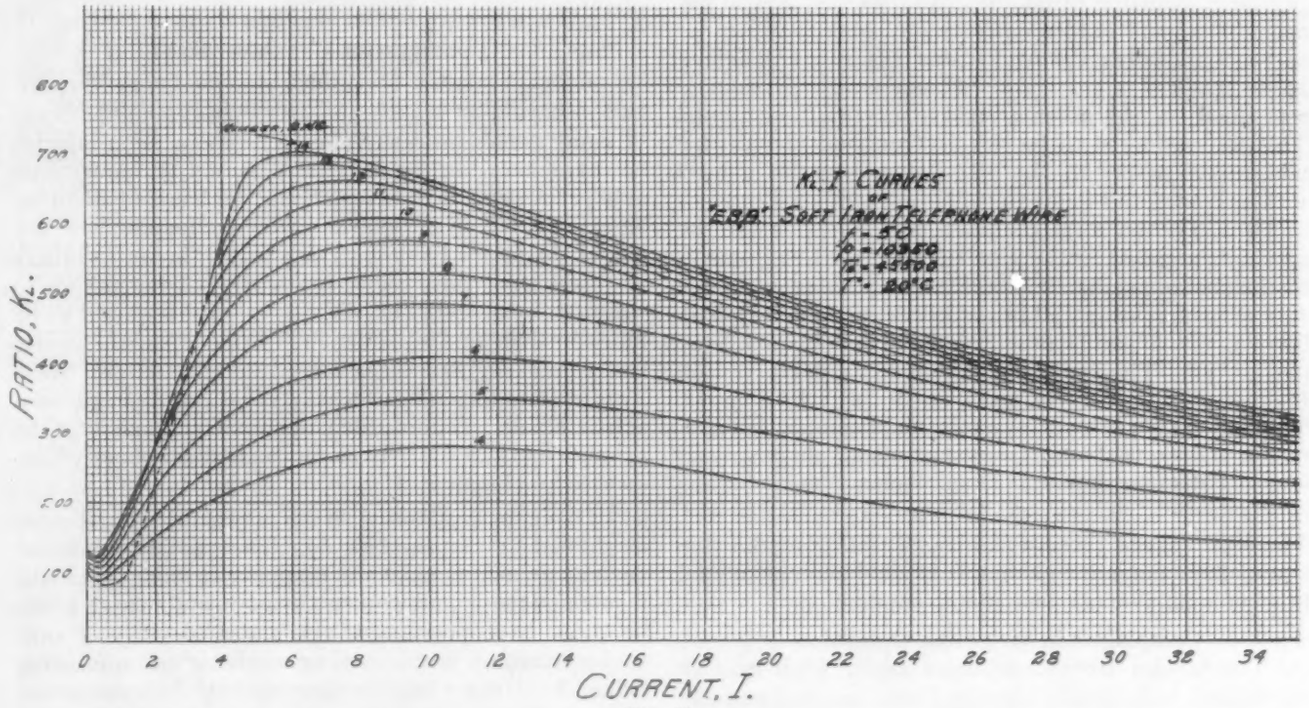


Fig. 22.

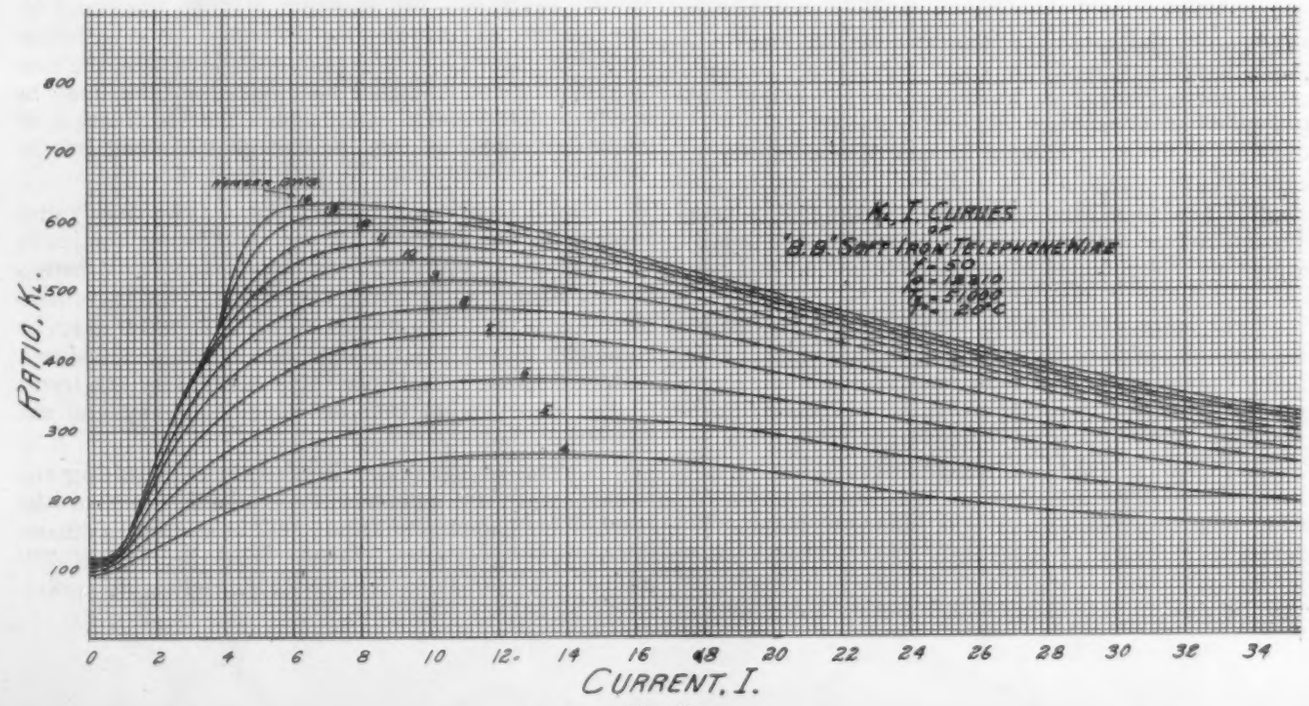


Fig. 23.

ELECTRIC POWER FOR IRRIGATION PUMPING

DEPARTMENT CONDUCTED BY S. T. HARDING

The operation and maintenance of canal systems present problems that are difficult and varied. In the following discussions may be found several important headings that have been gathered from recent field experience.

Cost of Cleaning Canals.

Canal cleaning where water carrying much silt is used is one of the principal costs of canal maintenance. The following results are taken from the 1915 report of R. S. Carberry, the superintendent of the Imperial Water Co. No. 1. The cleaning of 294 miles of canal cost $102.50 per mile. Clearing 30 miles cost $68.60 per mile. Cutting brush on 223 miles cost $34.50 per mile. Disc and grader outfits were used on 307 miles of canal to widen the banks, discourage growths and make roads at a cost of $20.40 per mile. A canal V was used on 361 miles at a cost of $81.25 per mile. This is considered to be the best method of cleaning where it is practical. In 1915 the size of the V used was increased and four caterpillar engines used in place of two. Of the total cost per mile $28 was for the actual V'ing, $23.50 the cost of repairs to equipment, $8 the cost of fuel and $21.60 the cost of Mexican labor following the V. In addition 3 dredges removed 270,000 cu. yds. from 53 miles of canal at a cost of 9½c per cu. yd. The system contains 335 miles of canal, the various items mentioned above total 1268 miles. This indicates the conditions of operation on this system where water is delivered throughout the year and requires the working over of each mile of canal by one or the other of these methods an average of 3¾ times. The total cost of these items was $101,000 or an average of $302 per mile. For the 108,224 acres irrigated this gives an average cost of 94c per acre.

Complaints in Irrigation Operation.

Complaints from consumers under both gravity canals and individual pumping plants are not entirely avoidable. The number can be reduced by the carrying out of well planned systems of delivery and prompt attention to the cause when complaints are made. It is particularly difficult to avoid complaints on large canals serving many farms under the necessary limitations of canal capacity and water supply.

One of the most effectual means of avoiding trivial kicks is to require that all complaints, to be considered, must be filed in writing. This reduces the number materially, as the grounds for complaint do not usually appear as important when reduced to writing and subject to definite verification.

Complaints are of two general kinds, those involving service and those involving costs. Under public utility regulation both service and rates are subject to public control and the company may be relieved of certain complaints which may arise from rules made by such regulatory bodies. Complaints regarding service on gravity systems are usually due to failure to deliver water promptly when scheduled, failure to get a sufficiently large irrigation head and damages from breaks. For individual pumping plants complaints on service may be due to interruptions in the power delivery. Such interruptions except for very short periods are usually of less frequent occurrence than interruptions on gravity systems following difficult alignment.

The most difficult form of complaint to overcome is that based on favoritism between users whether real or fancied. If users under a canal feel that all are being treated alike and that a fair effort for efficient operation is being made, the majority will not complain over ordinary interruptions. Where a feeling becomes established that favoritism is being shown, co-operation from the users is more difficult to secure and those not favored are alert for grounds of complaint.

Damages for Canal Breaks.

Damage claims for injury due to breaks in irrigation canals or failure of water supply are the cause of many controversies. The liability for such injuries varies somewhat in different states and questions arising in particular cases should be handled as other legal matters. In general canal companies are not insurers and are liable only for such injuries to others as result from their own negligence and the failure to use reasonable care and skill. The care required to be used is that which ordinarily prudent men exercise under like circumstances when the risk is their own. This applies to both general seepage and damage from actual breaks. The burden of proof is usually on the canal owners to show that the canal was properly constructed and operated.

Damages are limited to the actual injury and must be proven by the one injured. The one injured is expected to use reasonable diligence to minimize the resulting injury, and cannot recover for damages which he could have prevented. If land is destroyed, such as by washing away, so as to have no remaining value, the damage may be measured by the value at the time of destruction. If permanently injured but not wholly destroyed, the damages may be measured by the loss in cash value or the difference in value before and after injury. If only temporarily injured the cost of restoring the land to its previous condition may be used to determine the damage. For destruction of growing crops, the damage can be measured by the value of the crop at the time of destruction.

Canal breaks which interrupt service may cause injury to areas served from the canal below the break due to failure to secure their water supply. Where a failure to deliver prevents planting a crop, the difference in rental value with and without water may be used as a measure of the damages. Damages due to a failure to secure water are often covered by the terms of the contract between the canal company and the consumer.

Several of the states have statutes requiring the canal owner to maintain the embankments of the ditches, etc., so that no injury will be caused to others. These provisions seem to emphasize the need of diligence and care more than to change the rules previously stated.

Who Builds Canal Bridges.

In all irrigated states the builder of canals across existing public roads is required to construct the necessary bridges. In Oregon, Nevada and Kansas the laws require the canal owner to maintain the bridge. In Colorado, Idaho, Montana and New Mexico the county maintains the bridge after it is built by the canal owner, usually after a stated period, such as one year, from the date of construction. In the other states provision is usually made for the maintenance by the canal owner unless by act of the county officers the maintenance is taken over by the county. Bridges on main roads at least are more often taken over by the county.

In the case of public roads opened across existing canals, the usual practice is for the county to construct the bridge. The canal owner is required to prepare the right of way so as not to obstruct the road but this does not include the bridge which is a part of the road itself. California statutes provide that no damages shall be given for the right to cross for a road when condemned across a canal.

Power is given to proper county officers to require canal owners to complete bridges across the canal within fixed periods after construction of the canal or after notice from the county. If the canal owner fails to construct the bridge within the time period, it can be constructed by the county and the cost collected from the canal owner.

Where canals cross private roads the arrangement regarding the bridges is usually made a part of the right of way agreement.

Protection of Ditches from Gophers.

Placing a ½-inch mesh galvanized wire in canal banks to prevent gophers burrowing through the bank has been used on the Salt River project according to the Reclamation Record for June. A narrow trench 3 or 4 ft. in depth is dug along the bank of the canal parallel with the canal and from 2 to 4 ft. from the high water mark. The wire is placed in the trench with its top a few inches above the high water line. The depth of the wire depends on the height of fill and size of ditch. Working from either side of the bank gophers are unable to go entirely through the bank because they are not able to cut through the wire. Five hundred feet of badly infested ditch was protected in this way. No breaks have occurred in this length. The cost varies from 20 to 30c per lineal foot, depending on the quality and weight of wire used and material excavated.

Free Boards on Flumes.

The free board which should be allowed on wooden flumes depends on the height of trestle, size of flume and regularity of flow to be expected. Profiles of flumes after one or more seasons' use will generally show variations from a uniform grade of from 2 to 6 inches. This is true even of well built flumes of over 30 or 40 ft. in height, and an allowance for this factor of 4 inches even for flumes on heavy trestles would seem as small as should be used. If the inlet does not bring the water to the flume with a gradually accelerated velocity water actions will take place, the water flowing in surges which may extend for some distance. These waves are of particular importance in flumes designed for high velocities. In some cases flumes flowing 3 ft. deep with velocities of 6 to 8 ft. per second have been observed to have waves with a difference in elevation between crest and trough of one foot, the difference occurring in less than 10 ft. of flume. For such cases, either the flume can be designed for the mean depth and an excess free board allowed or a value of "n" can be selected sufficiently high to give a depth sufficiently large to cover the maximum depths. Where conditions permit, prevention by careful design of the inlet transition is the best method. For flumes turning across depressions from side hill canals this may be difficult to obtain. The value of "n" in wooden flumes is usually higher for irrigation practice than the figures given in some hand books. The results of experiments indicate that values of less than .013 should seldom be used and that in cases of crooked alignment or worn material the value may be as high as .015. From these various considerations it would seem desirable to allow a minimum free board of 6 in. on flumes 24 in. in depth and an additional amount on larger sizes equal to from 1-4 to 1-5 of the depth.

Cost of Pumping.

The U. S. Reclamation Service had 24 irrigation pumping plants in operation in 1914. The total capacity of the prime movers was 10,472 h.p. divided into 43 units. The lifts varied from 4 to 188 ft. The first cost of the plants was $785,000. During 1914, 400,484 acre feet of water were pumped. The average cost of all pumping, expressed in cost per acre foot of water raised one foot, was 2.10 cents on the Salt River project; 0.368 cents on the Minidoka project, 1.6 cents on the North Dakota Pumping project, and 0.531 on the Huntley project.

Power Rates on Minidoka Project.

The standard contract rates for electric light and power on the Minidoka project in 1914 were as follows:

	Per kw.-hr.
First 50 hours' use of maximum demand	$0.04
Next 50 hours' use of maximum demand	.03
Next 150 hours' use of maximum demand	.01
Balance hours' use of maximum demand	.005

Above rates increase 25 per cent during June, July and August.

The rates are subject to the following discount:

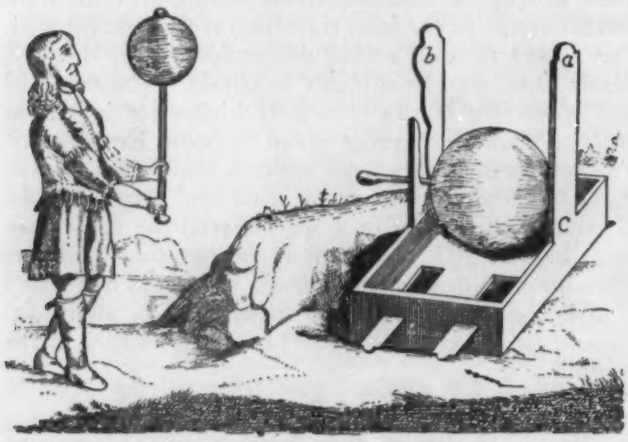
For a maximum demand of	Per Cent.
2 kilowatts and less than 4 kilowatts	2
4 kilowatts and less than 7 kilowatts	4
7 kilowatts and less than 11 kilowatts	6
11 kilowatts and less than 15 kilowatts	8
15 kilowatts and less than 19 kilowatts	10
19 kilowatts and less than 24 kilowatts	12
24 kilowatts and less than 29 kilowatts	14
29 kilowatts and less than 35 kilowatts	16
35 kilowatts and less than 41 kilowatts	18
41 kilowatts and less than 48 kilowatts	20
48 kilowatts and less than 57 kilowatts	22
57 kilowatts and less than 67 kilowatts	24
67 kilowatts and less than 80 kilowatts	26
80 kilowatts and less than 100 kilowatts	28
100 kilowatts and over	30

The minimum payment shall not be less than $1.80 per month per kilowatt of the contractor's agreed maximum demand. All the above rates are subject to 10 per cent discount if the energy is delivered and metered at approximately 2,200 or more volts or 8 per cent if delivered at approximately 2200 or more volts and metered at a lower voltage.

COINCIDENCES AND ANTICIPATIONS OF DISCOVERY.

BY A. L. JORDAN.

Bell and Gray filed applications for patents on a telephone receiver within two hours of each other, Feb. 14, 1876; Berliner and Edison invented important forms of telephone transmitters within three months of each other in 1877; Edison in America and Swan in England brought out successful carbon filament incandescent lamps in 1879; patent applications for a compound



Von Guericke's First Electrical Machine in Seventeenth Century.

dynamo were filed by Field, by Edison and by Siemens in 1880, again within three months' time; Tesla, de Ferraris and Dobrowolsky independently invented rotating field motors in 1886; Ferranti in Italy and Colby in the United States, four months apart in 1887, developed the important type of induction electric furnace.

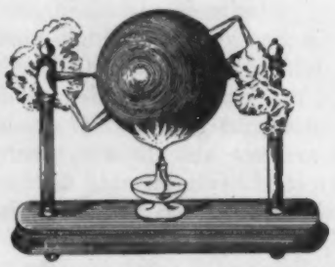
Going back a little, other coincidences were the invention of the electro magnet by Sturgeon (England), and by Henry (America) in 1825 and 1828; the self-exciting feature of the dynamo by Werner Siemens (Germany), and Charles Wheatstone (England), in 1867 (claimed by others, however); Paccinotti in Italy (1864) and Gramme in France (1870) independently developed the ring armature for dynamos; Schwiegger and Poggendorff, working separately, discovered the use of a coil of many turns of wire for a galvanoscope; Elihu Thomson and Fleming invented the inclined coil type of measuring instrument for alternating currents; Schallenberger and Tesla (1888 and 89) discovered a method of changing single-phase current to two-phase; finally, Dobrowolsky, Scott and Steinmetz (about 1891-94) found means of changing current of a certain number of phases to current of a different number of phases.

In lines other than electrical, there have been similar coincidences. The law connecting volume and pressure of gases was published by Boyle (in England) in 1862, but was discovered independently by Mariotte in France a short time later. One other well known law, that stating the relation between pressure (or volume) and absolute temperature, was discovered by Charles (France) in 1787, but was rediscovered by Dalton (England) in 1801.

Anticipations have been numerous, but in many cases the man who brought about the commercial development of the invention is the one deserving the greater credit. Dollond, who invented the achromatic lens in 1757 was antedated by Hall (1729) but the latter's discovery had been forgotten; Oersted's great discovery of the deflection of a magnetic needle in 1819 is said to have been anticipated at least partially so, by Romagnosi and by Mojon, about 16 years earlier; Ohm's law of resistance, electromotive force and current, published in 1826 had been discovered by Cavendish in 1800; Stephen Gray in the discovery of conductors and insulators (1729) was anticipated by von Guericke (1673); Musschenbroek in his Leyden jar (1746), by von Kleist (1745); D'Arsonval with his moving-coil galvanometer (1882), by Sturgeon (1836); Elihu Thomson with the first successful watt-hour meter (1885), by Ayrton & Perry (1883), in England; Maxim with his famous "silencer" by Elihu Thomson's muffler, patented in 1907; the latter's universally used commutating pole dynamo, patented in 1885, was foreshadowed at least by the "slotted pole" suggestion of Silvanus P. Thompson, years before.

In the history of wireless telegraphy there are several cases of independent discovery. Following Maxwell's remarkable prediction in 1864 of the possibility of waves in the other came the world-stirring experiments of Hertz in 1888. Then after the famous coherer discovery by Branly in 1890, attention was called to the fact that it had been anticipated by the work of Munk (1835), of S. A. Varley (1852), of Hughes (1878) of Calzecchi-Onesti (1884) and of Lodge (1889). Fessenden in the discovery of the effectiveness (audibility) of musical sounds having about 920 vibrations per second was antedated by Lord Rayleigh.

Lastly, in certain cases, the very name by which the apparatus is known is not that of the discoverer. Hero or Heron, the Greek, whose name is attached to the steam reaction globe (B. C. 150) was evidently only the historian of the appliance, the real discoverer



The First Steam Turbine, About 150 B. C.

being unknown. Wheatstone was not the inventor of the Wheatstone bridge (which he used in 1845) and he freely acknowledged that the credit was due to Christie (1833). D'Arsonval, as has been mentioned, did not invent the galvanometer which bears his name; it was a contrivance of Sturgeon. Ruhmkorff began to manufacture the Ruhmkorff coil in 1851; it was the induction coil of Page (America) in 1836. Venturi had no part in the development of the Venturi water meter; it was brought out by Clemens Herschel in 1888, the name being given in honor of Venturi, the Italian physicist (1746-1822) whose work on discharge orifices or nozzles is well known.

SPARKS—CURRENT FACTS, FIGURES AND FANCY

About 50,000,000 pounds of copper were sold in New York recently at 26½c per lb. What a difference from former prices of 13 and 14 cents.

* * *

Since the beginning of the war the deposits in the banks of Copenhagen have been increasing. The combined balances of its banks now total $468,000,000.

* * *

Building permits for the first seven months of 1916 totaled nearly $610,000,000, which is an increase of 29.4 per cent over the corresponding period of 1915.

* * *

The total operating revenues of the Bell telephone system in the United States for the first half of 1916 were $127,500,000 an increase of $13,029,000 over the first half of 1915.

* * *

Russian colonists are to be transferred from Riga to South America at the close of the war. It is said these immigrants will be very desirable citizens and possessing sufficient means to finance themselves.

* * *

California is not alone in its efforts to foster the domestic rice industry. The Argentine ministry of agriculture is experimenting on an extended scale with Chinese, Japanese, Italian and Spanish varieties of rice.

* * *

The Australian government is now taking over all rabbit skins for the manufacture of military hats. The highest price paid is forty cents per pound. California ought to develop a new industry and get into the market.

* * *

Reports of the International Institute of Agriculture indicate that the world's crop this year will be less abundant than last, but that harvest prospects are better than the average in the five-year period of 1909-13.

* * *

In spite of the conditions brought on by warring internal conditions, the total foreign trade between Mexico and the United States during the past year was $119,080,000, an increase of forty per cent over the previous year.

* * *

The average installation of hydroelectric plants at the present time in first cost will amount to not less than $150 per kilowatt of capacity. A first-class steam plant today, depending on the size, costs from about $55 to $75 per kilowatt capacity.

* * *

There has recently been incorporated under the law of the state of Connecticut a new bank known as the "Banco Mercantil Americano del Peru," and having for its purposes the development of trade in Peru and the promotion of trade between that country and the United States.

The Panama canal is practically completed, according to an announcement from the Isthmian canal offices. The great work will cost in all, including fortifications, the sum of $420,000,000.

* * *

To assist old father time in hastening the hours the Chilean government by official decree has advanced all watches and clocks by approximately sixteen minutes, in accordance with the meridian of the National Astronomical Observatory at Santiago.

* * *

American exports for the year ended with June, 1916, amounted to $4,345,000,000 and the imports were valued at $2,180,000,000, making a total foreign trade of $6,500,000,000, which is much larger than any previous total in the history of American commerce.

* * *

One hundred and thirty thousand maps of the national forests are being distributed to tourists this summer. These maps show the best camp sites, good hunting and fishing grounds, roads, trails, and telephone lines, and give directions how to reach points of interest.

* * *

As an indication of the increased interest evinced by central stations in the work of the Society for Electrical Development, it is announced that recently one hundred and forty-one central stations have become members. The increased memebrship is representative of all parts of the country.

* * *

The largest oil delivery contract ever made in the history of that industry was recently signed in San Francisco calling for a maximum daily delivery of 50,000 barrels at a cost of about $18,000 per day. The deal is between the Mexican Petroleum and the Cunard steamship companies.

* * *

The system of propulsion being installed on the "Tennessee," a U. S. super-dreadnaught of the largest and finest class, differs from any now in use by battleships. Instead of the propellers being mechanically connected to the driving engines or turbines, there are two steam turbines developing over 33,000 h.p. driving electric generators which furnish current to members.

* * *

The rapidity with which we are progressing in invention is well illustrated by the advance of the telephone. In forty years the Bell telephone companies have invented, used, and thrown away fifty-three styles of telephone receivers and seventy-three styles of transmitters. The average age of all the 12,000,000 telephones in use today throughout the United States is less than five years.

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Change of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon Monday dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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The Value of the Battering Ram

In the good old days "when knighthood was in flower," if it was desired to capture a walled city, a long beam was rigged up with a heavy metallic end-piece shaped in the form of a ram's head. This was as a rule suspended from a frame and by being swung to and fro was caused to batter against the opposing wall until it finally caved in. Although the first blow hardly ever accomplished the desired result still if subjected to its continual pounding the stronghold of the enemy was sure to fall. And so such a process of consistently pounding away became known as the Battering Ram method of attack.

In the busy commercial life of modern days we can all draw a most useful lesson from the ancients—namely the success bound to come if we consistently apply the battering ram process of attack. This can be most forcefully brought out in modern methods of advertising and especially in methods of window displays for electrical contractor-dealers.

A display of too many different varieties of electrical appliances simply batters against too large an area without accomplishing the results sure to follow if one pounds away at one particular point.

Thus the electrical contractor-dealer who groups his window for a series of days, displaying all about—say flash lights—makes the impression and lands the business. On the other hand, a display of a dozen different articles bearing no relationship one with the other, makes no definite impression and consequently fails to win the commercial campaign desired.

The stone builder desiring to rupture a granite block scarcely ever accomplishes the result in one stroke. In the more usual case many strokes concentrated at the same point are necessary. And when the rock finally ruptures it can not be said that the last effort did the work. It must be admitted that each pounding of the sledge hammer must have contributed its individual share.

This battering ram process has all history back of it for effective results. Try it.

Every Day Use of the Metric System

It is generally recognized that one of the few great benefits to the human race that resulted from the horrors of the French Revolution was the birth of the metric system of measurement.

A hundred and twenty-seven years have passed since that epoch and now the metric system is universally recognized as the one simple, accurate and scientific unit of measurement. Nevertheless, step out into the street and talk to the layman about kilometers of distance or liters of water per hectaire required in irrigation and you get the same glassy stare that comes over the easterner's face when he hears that eggs are selling for two-bits a dozen upon his first western visit.

The practicing engineer is little better. Fundamentally, he understands the metric system of course, but he thinks, works and lives in feet, degrees Fahrenheit, acres, second feet of water, British thermal units, and a horde of other irreconcilable and illegitimate units—complex in themselves but familiar to him because he has been reared in their use.

The English speaking peoples are far behind other nations of the world in putting the metric system first and foremost. The reorganization of the world's trade and the enforced world prominence of America now demand a radical change in this particular. The British public are themselves wakening to the signs of the times. British engineering societies are urging the paralleling of all figures with the metric equivalents and their complete adoption in the near future.

In America the engineering fraternity should take it as a keen rebuff that the National Wholesale Grocers' Association have taken it upon themselves to take the initiative in the printing and labeling of canned and boxed goods with the metric equivalents.

We are all slaves of habit. It took five hundred years to displace the cumbersome Roman numerals for the flexible Arabic system of numbers now in vogue. Let us profit by this experience and each and everyone begin to think more in metric units and at an early date relegate to the scrap heap forever, our ancient and awkward English system of units.

Courtesy

Courtesy, developed to its highest ethical standard, may almost be defined as that divine something which emanates from a human being in such a manner that all life and even nature itself seems to feel at perfect ease. Practically speaking, courtesy is the expression of voice and action so sincere in its effort to reach the other fellow, that the individual possessing it loses sight completely of his own individual selfish interests, thinking only of the common good.

It is remarkable to what extent true courtesy makes for success in modern business life. Its precepts are in these later days being lauded and heralded on all sides and the close observer cannot but come to the conclusion that after all it pays big dividends.

A few years back the claim department of a public utility company largely spent its time in "get to ——" interviews and "go to ——" correspondence. On another page of this issue the head of the claim department of a large western utility company discusses the fundamentals of a modern claim department. Upon its careful perusal the conclusion is soon drawn that courtesy in its highest and truest sense is the most valuable asset on the part of the company's agents in disposing of claims with financial advantage to the company.

The claim agent should ever bear in mind that whether a man has been wronged or not, if he thinks he has been wronged, the harm is there just the same. And courtesy is the great reagent by which such unreal conditions are softened and finally made to disappear without a scar.

This is only one of the many instances that may be cited where the development of true courtesy proves to be one of the most valuable virtues the modern business man may possess.

We are all weary pilgrims endeavoring with the light that is given us to pass through the land with our full share of success. Let us remember, then, that it is an old saying but a true one—"with hat in the hand we pass through the land."

Inventive Genius—No Monopoly

On another page of this issue is detailed an extensive series of apparent coincidences in discovery and invention. It is a fact often commented upon in every one's personal and business experience of how certain identical solutions to social and business problems often simultaneously suggest themselves to various individuals after independent thought on the part of each. Upon close reasoning we must come to the conclusion that invention is itself nothing but a similar phenomenon. The inventor, familiar with some newly discovered law of physics or chemistry, proceeds to combine in thought this new addition to his mental family of ideas and, if of a practical turn of mind, a useful invention is the result. A second person with similar experience likewise may go through the same mental process and arrive at identically the same useful conclusion.

Not only have simple inventions been thus simultaneously thought out, but even inventions in the most intricate mathematical reasoning have been wrought out independently and simultaneouly. Thus Newton, Leibnitz and another famous mathematician, absolutely independent of each other, invented the intricate and deep-reasoning calculus now the foundation stone for modern engineering mathematical reasoning.

The moral to be drawn from all this is that the human brain is a machine of delicate combinations which with careful and thoughtful application we may all train to serve us in the invention of new and practical mechanisms or business methods.

Method in modern business organization and business getting is the great need of the hour. Those who have risen to pre-eminence in business affairs have largely done so by carefully applying the principle of recombining experiences and incidents that have come under their personal notice in order to produce new and more effective methods.

It is now accepted as an historical fact after the comparison of the struggles of great men in their upward course of success that genius is one-tenth inspiration and nine-tenths perspiration.

We all have it in our power, then, to vastly increase our usefulness in the business and social world by quiet and consistent thinking and planning. This is indeed the highest and most useful form of invention.

PERSONALS

Joseph Sacks, inventor of the "Noark" fuse, is at San Francisco from Hartford, Conn.

H. C. Houck, manager supply department General Electric Company, is at San Francisco.

C. E. Patterson, controller General Electric Company, is at San Francisco from Schenectady.

F. B. Nightingale, salesman with Los Angeles office of the General Electric Company, is at Lake Tahoe.

G. L. Ohman, auditor Portland office General Electric Company, was at San Francisco during the past week.

D. M. Speed, auditor San Joaquin Light & Power Corporation, has returned to Fresno from a trip to San Francisco.

R. J. Cash, manager Los Angeles office General Electric Company, has returned from a trip to Northern California.

A. J. Bowie, Jr., of the Bowie Switch Company, has returned to San Francisco from a trip through Northern California.

E. Darrow, manager Spokane Heat, Light & Power Company, of Spokane, Wash., was at San Francisco during the past week.

W. J. Davis, Jr., Pacific Coast engineer General Electric Company, is making an extended trip through the Pacific Northwest.

F. H. Leggett, Pacific Coast manager Western Electric Company, is attending a district managers' convention at Hawthorne.

H. N. Kiefer has resigned as sales engineer with the Northern Electric Co. Ltd., of Vancouver, B. C., and has gone to New York City.

A. E. Drendell, manager Drendell Electric & Manufacturing Company of San Francisco, is hunting in the wilds of Siskiyou county, California.

E. H. Cheney, sales supervisor Wagner Electric Manufacturing Company, has returned to Chicago after visiting all Pacific Coast cities.

Franklin T. Griffith, president Portland Railway, Light & Power Company, has been elected president of the Portland Chamber of Commerce.

Simon Bamberger, formerly president of the Salt Lake & Ogden Railroad Company, is Democratic nominee for governor of Utah in the coming campaign.

A. H. Halloran, vice-president and managing editor Journal of Electricity, Power and Gas, has been appointed Pacific Coast representative Society for Electrical Development.

A. V. Guillou, formerly extension engineer with the Pacific Light & Power Corporation of Los Angeles, is now district manager in the Porterville office of the Mt. Whitney Power & Electric Company.

R. C. McFadden, formerly with the Puget Sound Traction & Power Corporation at Seattle, has charge of the Pacific Light & Power Corporation's new electric cooking and heating bureau at Los Angeles.

Charles J. Thelen, well and favorably known in electrical supply circles, is closing the affairs of Bill & Thelen and will join the sales organization of the Electric Railway & Manufacturers' Supply Company on September first.

R. G. Hunt, assistant to the vice-president in charge of operation, and **B. W. Lynch,** assistant to the general auditor, are completing an inspection trip to Pacific Coast utility properties managed by H. M. Byllesby & Co.

W. A. Thompson, of the Federal Sign System (Electric), has just returned from completing a five months' sign campaign for the newly re-organized Idaho Power Company. He is now active in the San Joaquin Valley of California.

W. D'A. Ryan, illuminating engineer General Electric Company, will leave San Francisco this week to attend the electrical convention at Seattle, where he will give a lecture on the "Illumination of the Panama-Pacific Exposition."

A. H. Griswold, plant engineer Pacific Telephone & Telegraph Company, leaves San Francisco this week to attend the Pacific Coast convention of the American Institute of Electrical Engineers, where he will present a paper on "Inductive Interference as a Practical Problem."

Harris J. Ryan, professor of electrical engineering at Stanford University, will give the response to the address of welcome and present a paper on the "High Voltage Potentiometer" at the Seattle convention of the American Institute of Electrical Engineers next week.

E. J. Kingsley, recently with the California Telephone & Light Company, and the Pacific Gas & Electric Company in the Santa Rosa, Petaluma and Sonoma districts, has been appointed special representative in Southern California for the Federal Sign System (Electric.)

L. A. Nott has resigned as assistant manager San Francisco office Standard Underground Cable Company, in order to represent a number of factory lines, with particular attention to the K. P. F. Electric Company of San Francisco where he will make his headquarters.

R. E. Smith, at one time Pacific Coast representative of the X-Ray Reflector Company and recently illuminating engineer for the Pacific Light & Power Corporation, has been appointed sales manager of the Mt. Whitney Power & Electric Company at Visalia. **C. S. Older,** formerly Los Angeles salesman with the Pacific Company, has been transferred to the sales department of the Mt. Whitney company.

S. M. Kennedy, general agent Southern California Edison Company of Los Angeles, **S. V. Walton,** commercial manager Pacific Gas & Electric Company of San Francisco, **H. A. Lennon,** new business manager Truckee River General Electric Company of Reno, and **A. H. Halloran,** managing-editor Journal of Electricity, Power and Gas, leave this week to attend the Seattle convention of the Northwest Electric Light and Power Association.

J. E. Woodbridge, resident manager Ford, Bacon & Davis, at San Francisco, has been elected chairman of the San Francisco Section of the American Institute of Electrical Engineers; **J. P. Jollyman,** engineer electrical construction Pacific Gas & Electric Company, is chairman of the papers committee, and **W. G. B. Euler,** superintendent of operation Great Western Power Company, is chairman of the entertainment committee. The others of the executive committee are **W. J. Davis, Jr.,** Pacific Coast engineer General Electric Company, and **C. A. Turner,** plant engineer's office Pacific Telephone & Telegraph Company. **A. G. Jones,** salesman General Electric Company, has been re-elected secretary.

ELECTRICAL SUPPLY JOBBERS' MEETING.

A meeting of the Electrical Supply Jobbers' Association of the Pacific Coast will be held at Hayden Lake (near Spokane), September 21-23, 1916.

CALIFORNIA STATE CIVIL SERVICE EXAMINATIONS.

The California State Civil Service Commission announces examinations to be held in San Francisco, Sacramento and Los Angeles, on September 23, 1916, to provide lists of eligibles from which to fill the positions of superintendent of construction of the architectural division of the department of engineering, and of assistant state engineer. The salary of the assistant state engineer is $3000 per annum, (statutory), and that of superintendent of construction $2400 at commencement, and $3000 maximum.

CALIFORNIA ELECTRICAL CONTRACTORS' NOTES.

The August monthly meeting of the California Association of Electrical Contractors and Dealers was held at the Hotel Cakland the evening of the 24th. The program was under the direction of the Alameda county section, Mr. Norman Ellis of Oakland presiding.

The greater portion of the evening was given over to the discussion of the various problems of the electrical retail dealer. A greater need of the increase of sales of appliances for the household was vividly set forth by several charts showing low per centage of sales for the quarter ending June 30, 1916. H. C. Kimball of Oakland, Lee H. Newbert and S. V. Walton of the Pacific Gas & Electric Company, San Francisco, and C. V. Schneider of Sacramento talked on the subject matter of the charts. Announcement was made of the admission of Mr. A. B. C. Dohrmann of Nathan-Dohrmann, San Francisco, to membership in the association.

Messrs. Lewis of the Fresno Electric Company and Courtright of the Valley Electric Supply Company, Fresno, told of conditions in the San Joaquin valley.

Geo. Sittman presented a paper on the subject of correct percentage for overhead and said it to be his personal opinion that a contractor could not conduct his business properly on less than 25 per cent.

Mr. Louis Levy of San Francisco, speaking from the standpoint of the electrical retail dealer called attention to the variety of prices at which various electrical materials are sold.

Among other speakers of the evening were J. C. Hobrecht, Sacramento; A. Mimema, Electric Appliance Company; D. E. Harris, Pacific States Electric Company; W. S. Berry, Western Electric Company; H. H. Hoxie, Electric Railway & Manufacturers' Supply Co., San Francisco, and W. C. Loveland, representing the electric contractors of San Mateo county, who are about to form a local in their section. It was decided to meet with the latter contractors at an early date and assist them in organization work. The meeting adjourned at 10:00 p. m., some 80 members being present.

NOTES OF CALIFORNIA RAILROAD COMMISSION.

California has established a record of stupendous public utility development under the regulation of the railroad commission. The commission has had jurisdiction over stocks and bonds for four years and five months. During that period it has authorized to be issued $664,000,000 of securities. Of this amount $316,000,000 has been for entirely new development; $181,000,000 has been for the refunding or payment of maturing debts; $128,000,000 has been for reorganization purposes and the balance has been for collateral and miscellaneous purposes.

Of the $316,000,000 that has been authorized for new development, more than $200,000,000 has already been invested, under the commission's jurisdiction, in new public utility undertakings, or is now being so expended. These new undertakings, either actually constructed or now being constructed, have called for capital investment at the rate of $3,750,000 per month, or $125,000 for every day that the commission has had its present authority.

This steady flow of capital has come from all parts of the world; from the biggest banking centers of Europe and America; from the largest financial houses and banks of New York, Chicago and elsewhere. Such institutions as J. P. Morgan & Co.; Kuhn, Loeb & Co.; Central Trust Co., of Chicago; Lee Higginson Co. of Boston; and the Continental & Commercial Bank of Chicago are among the list of financial houses of national repute which have been attracted by the investment possibilities of California's public utilities.

The list also includes financial institutions of national scope which had hitherto refrained from investment in California, including the largest group of investment bankers in the middle west.

During this same period Californians have invested in their public utilities in greatly augmented amounts and increased numbers. The public utilities of the state have added 7000 to 10,000 new stockholders.

At the same time the public utility securities have, by reason of the commission's supervision, become a safer investment for the public's funds.

Under this same jurisdiction of the railroad commission power companies have initiated or carried forward projects embracing 125,000 additional horsepower, at a cost in excess of $25,000,000.

Among the new railroad developments in California is included:

The Northern Electric, Marysville-Colusa Branch, from Marysville to Colusa, a distance of 22 miles, in the Sacramento valley, costing $900 000.

The Oakland, Antioch & Eastern Railway, 100 miles in length, connecting San Francisco and Sacramento, costing approximately $6,500,000.

The Sacramento Valley Electric Railway, a twelve-mile line, from Dixon to a connection with the Oakland, Antioch & Eastern Railway, costing $250,000.

The gas and electric development has included an expenditure of more than $75,000,000 under the commission jurisdiction. This development has embraced the establishment of fourteen entirely new companies and the extensive development of the previously established gas and electric companies.

The Pacific Gas & Electric Company, in the San Francisco bay territory and the Sacramento valley; the Great Western Power Company, in the same territory; the Southern California Edison Company, in Los Angeles and surrounding counties; the Pacific Light & Power Corporation, in the same territory; the Southern Sierras Power Company in the southern mountain counties, San Bernardino County and the Imperial Valley; the San Diego Consolidated Gas & Electric Co. in San Diego and vicinity; the San Joaquin Light & Power Corporation, in the San Joaquin Valley; the Mt. Whitney Power & Electric Company, in the lower San Joaquin Valley; the Western States Gas & Electric Company, in Eureka and Stockton, together with scores of other gas and electric companies, have expended $75,000,000 in development work during the past four years, including the installation of mammoth hydroelectric projects, the extension of distribution systems in all of the cities of the state, and the construction of transmission and distribution lines for agricultural and irrigation purposes in nearly every county in California.

These enterprises have included the construction of great dams and reservoirs. They have been on a scale which has established California's pre-eminence in hydroelectric development.

Every reasonable public utility requirement of the state is met as fast as the necessity arises. Capital is flowing into these California projects in greater volume than ever before.

TRADE NOTES.

Trost Apartments, Twenty-sixth and Howard streets, San Francisco, have been equipped with 42 Westinghouse electric ranges, power being furnished by the Great Western Power Company.

After Oct. 1, 1916 the San Francisco offices of the Westinghouse Electric & Manufacturing Company, the Westinghouse Lamp Company and the R. D. Nuttall Company, will be in the First National Bank Building, where the seventh floor is now being fitted for their occupancy.

The Utah Power & Light Company have placed an order with the Federal Sign System (Electric) for a sign to be installed on the front of the Kearns Building in Salt Lake City, where the company's general offices and the office of

the Salt Lake division are located. The sign is a vertical one and the company's name will be spelled out in full. It will be made of Federal standard 24 in. enameled steel letters surrounded by a border representing a series of fountains. The sign will be seventy-three feet in height over all and will contain 1200 ten watt lamps. The order for this sign was secured by Rufus Johnson, sales representative of the Federal company at Salt Lake City.

The Pacific Gas & Electric Company is putting up a $150,000 building at Seventeenth and Clay streets, Oakland. The height of the Lake Spalding dam is being raised 35 feet. During August and September the company is paying a bonus to dealers in smaller towns selling gas appliances. This is an experiment to determine whether the dealer can be interested in the matter.

The Lewiston Bear Lake Irrigation Company has awarded to the Salt Lake Hardware Company the contract for the installation of four Allis-Chalmers pumping units of 45,000 gallons per minute total capacity. These units are to be installed on the Bear River two miles west of Fairview, Idaho. The installation, including the pumping station, diversion canal and pipe line will involve an expenditure of $70,000. The Utah Power & Light Company has contracted with the irrigation company to supply the power required for driving this installation which will have an aggregate connected load of 1400 horsepower. The power will be supplied from the Grace and Oneida plants on the Bear River which are only a short distance from the side of the pumping plant. The plant will work against a head of approximately ninety feet and will deliver the water through a five foot concrete pipe approximately three hundred feet long, which will discharge it into the irrigation canal; 10,000 acres of land will be supplied by the project.

NEW BULLETINS AND CATALOGUES.

The tenth edition of a booklet entitled, How to Build up Furnace Efficiency, by Jos. W. Hays, combustion engineer, of Rogers Park, Chicago.

The General Electric Company has just issued Bulletin No. 46201 on Single-Phase Watthour Meters, Bulletin No. 46253 on Polyphase Watthour Meters.

Frederick J. Drake & Company, a publishing house of Chicago have just issued a twenty-five page leaflet setting forth various books carried in stock or practical mechanics for home industry.

The State Highway Commission of Oregon has just issued Bulletin No. 1, entitled Outline of Road Laws of Oregon. This outline is primarily intended to facilitate the study of existing road laws with a view to their improvement.

A close-up view of Louise Lovely, the Bluebird Photoplay star, operating the C-H Magentic Gear Shift with which her motor car is equipped, makes a very attractive cover for a four-page two-color folder now being distributed by the Cutler-Hammer Mfg. Co., of Milwaukee.

"Standard Methods of Gas Testing" is the title of circular No. 48 just issued by the Bureau of Standards. Methods are set forth for determining the heating value (or candlepower), purity and pressure of gas supplied and the accuracy of the gas meters in use. The bulletin should prove very helpful to those engaged in gas testing and standardization.

The Bureau of Standards has issued Scientific Paper No. 286 entitled "The Determination of Aluminum as Oxide." This paper gives the results of a research to define the conditions for the determination of aluminum. From observations made with a hydrogen electrode and with suitable indicators, the conditions for the quantitative precipitation of aluminum hydroxide by ammonium hydroxide were determined.

The Bureau of Standards, Department of Commerce, has just published a paper which describes a new form of instrument for varying that property of an electrical circuit (self inductance) which opposes any change in the strength of a current, just as the inertia of a heavy train of cars opposes any change in its speed. Copies of this report, Scientific Paper No. 290, are ready for distribution.

The Pelton Water Wheel Company have issued a new publication dealing with Pelton-Doble Centrifugal Pump. While centrifugal pumps have been a product of this company for a number of years, it is only after a careful study of performances that they have decided to place these on the general market. The Pelton-Doble centrifugal pump is rather unique in many features, perhaps the most notable being the uni-diffusion system of the volute. This is a material aid in securing the high efficiencies for which the Pelton-Doble pump is chiefly noted.

It has recently been announced that the Navy Department intends to re-engine ships in the service that are now equipped with direct connected turbines. The first two to be so reconstructed will be the destroyers Henley and Mayrant. These are to be equipped with geared turbine units, for which contracts have been placed with the Westinghouse Machine Company of East Pittsburgh, Pa. Geared turbines have been decided upon due to the fact that they are lighter and take up less space than direct connected units, are much better mechanically because of their small size, and materially reduce steam consumption at all speeds and especially at cruising speeds. This reduces the fuel consumption and increases the steaming radius, which is an important feature.

In a laboratory in which a large number and variety of electrical instruments are tested, it is important that means be provided for the rapid and accurate control of the electric generators which provide the current for testing. In Scientific Paper No. 291 by P. G. Agnew, W. H. Stannard and J. L. Fearing, published by the Bureau of Standards, an elaborate system of this kind which is in use at the Bureau described.

The Bureau of Safety, 72 West Adams street, Chicago, have just issued six excellent sixteen page leaflets entitled Hazards of Gas Works, Fire Prevention in Electrical Stations, Think, Heads Up, What is Ordinary Care, The Spirit of Safety. Everyone interested in safety should secure a copy of these bulletins as they are issued. A series of helpful shop bulletins are also being published for display purposes in the shops where men are working.

BOOK REVIEWS.

Electrical Motors. By David P. Morton, B.S., E.E.; 4x6 in; 241 pp.; 115 illustrations. Published by Frederick J. Drake & Co., of Chicago, and for sale at Technical Book Shop, San Francisco. Price $1.00.

This book includes a discussion of electric motors, both direct and alternating, setting forth in a clear, easy manner for the practical man their principles, construction, operation and maintenance. The author is associate professor of electrical engineering at the Armour Institute of Technology. A number of helpful examples are given throughout the book which should prove useful in assisting one to grasp the practical principles that are involved.

Electrical Tables and Engineering Data. By Henry C. Horstmann and Victor H. Tousley; 4x6 in; 331 pp.; replete with tables and illustrative problems. Published by Frederick J. Drake Co. of Chicago, and for sale at Technical Book Shop, San Francisco. Price $1.00.

The authors of this work have written some ten other similar practical publications. This volume is a book of useful tables and practical hints for electricians, foremen, salesmen, solicitors, estimators, contractors, architects and engineers. In a word the book is an attempt to furnish electricians generally and others interested in electrical work with a reference and table book which can be conveniently carried in the pocket; and as such the book will be found very useful.

NEWS NOTES

INCORPORATIONS.

IDAHO FALLS, IDAHO.—The East Idaho Gas Company has been incorporated with a capitalization of $125,000. The necessary franchises have been secured and it is planned by the officers of the company to have the gas ready for use in part of the city at least by June 1, 1917, and the plant completed by October 1, 1917. Sixteen people are named as incorporators, 13 of them being Chicago men, and James E. Doyle and W. D. Wilcox, formerly Chicago men, now of Idaho Falls, and A. V. Scott, the local representative on the list of incorporators.

ILLUMINATION.

NEWMAN, CAL.—C. S. S. Forney is making preparations to install a gas system in this city.

TEMPO, ARIZ.—Interest in a municipal electric lighting plant has been revived by the city council.

MELSTONE, MONT.—The question of bonding in the sum of $6000 for constructing a light plant is being considered.

DOUGLAS, ARIZ.—The city engineer has presented plans and specifications for a new street lighting system to the city council.

LOS ANGELES, CAL.—All bids recently received for lighting fixtures for the Hall of Records by the board of supervisors and new bids will be received up to September 11.

BRAWLEY, CAL.—The city council has awarded a contract to the Holton Power Company for the installation of a street lighting system at $1500.

PALO ALTO, CAL.—The city council is preparing to call an election to vote on the issuance of bonds for the purchase of the property of the Palo Alto Gas Company.

LOS ANGELES, CAL.—A petition has been filed with the board of supervisors for the establishment of the Athens Lighting District. A hearing will be held on September 11.

LOS ANGELES, CAL.—The city council has ordered ornamental lighting posts and appliances installed and maintained on Hollywood boulevard between Wilcox and Cherokee avenue.

GOLDFIELD, NEV.—The county commission has granted to H. H. Dunbar, on behalf of J. B. Fayant, a franchise for laying mains, connecting pipes and installation of gas reservoirs in Goldfield.

FULLERTON, CAL.—First steps in an effort to secure ornamental lights here have been taken by property owners. A petition to the city council recommends single reinforced concrete lighting standards.

MANHATTAN, CAL.—The Southern California Edison Company has been awarded the contract for lighting district No. 11. The figure for single lights was $1.10 per month and for clusters $2.30 per month.

TULARE, CAL.—Fred G. Hamilton, superintendent of the western division of the Mt. Whitney Power & Electric Company, has submitted a proposition to the city trustees for the extension of the street lighting system. The plan calling for the installation of 34 lights, has been referred to the street committee.

YUMA, ARIZ.—The Title Insurance & Trust Company of Los Angeles, as trustee, has taken possession of the properties of the Yuma Electric & Water Company and the Yuma Gas Company and will operate those concerns in the interest of the bondholders. The properties supply the city with light, gas, water and power.

FRESNO, CAL.—The matter of securing estimates for the construction of the electrolier system in the court house park has been turned over to Russel Uhler, county purchasing agent, and the county may install its own lights at a cost of about $10,000. The system calls for about 100 electroliers, similar to the ones in the city.

SALT LAKE CITY, UTAH.—The Utah Power & Light Company has commenced work on the installation of the special street lighting system for Salt Lake City, comprising lighting improvements in district number two, whch was recently created by petition of the property owners. The contract for the installation of this system calls for an ornamental standard which is fitted over and around the regular steel trolley poles and completely concealing them. Mounted on the top of this standard is three five-ampere luminous arc lamps of the luminous type. The standards are 100 ft. apart on each side of the street. It is expected that at least one block of the installation will be ready to illuminate at the opening of the festival of the "Salt Princess" which will be held at Salt Lake City, September 11th.

TRANSMISSION.

LOS ANGELES, CAL.—Fire completely destroyed the Pacific Electric hydroelectric power plant in Upland, with a loss of $20,000.

SEATTLE, WASH.—Martin & Dugan, Northern Bank building, Seattle, are in the market for cables, castings, bolts, turnbuckles, insulators, etc., in connection with the erection of wooden radio masts at North Head, Wash.

KINGMAN, ARIZ.—Geo. H. Thayer, head of the hydroelectric scheme on Burro Creek, has been in Kingman arranging for the acquisition of a franchise for stringing power lines in all towns and mining camps in the county. The company is operating on Burro Creek and has a large number of men at work getting things into shape for building the dams.

OROVILLE, CAL.—Plans for the construction of the second power plant to be constructed by the Great Western Power Company call for an expenditure of $25,000. The plant is to be located on the north bank of the North Fork, at Smith's Point above Belden. The water will be brought from Lake Almanor in a great concrete aqueduct. The capacity of the new power plant will be 100,000 h.p. To accommodate the increased power, a second tower line from Las Plumas to San Francisco will be built. Work is expected to be well underway in 1917.

TRANSPORTATION.

NEWPORT, ORE.—According to Dr. A. J. Fawcett of this place the Portland & West Coast Railroad & Navigation Company will start construction of its line between here and Portland. It is to be an electrical road.

LINDSAY, CAL.—Work has started at Strathmore on the new extension of the Visalia electric and line running into the El Mirador country. The next move of the electric company will probably be the branch into Lindsay for the routing of which the company is now working out.

SEATTLE, WASH.—The Seattle & Rainier Valley Railway Company is to suceed the Seattle, Renton & Southern Railway Company. New construction proposed by the company will consist of tracks on Dearborn street, from Fifth avenue south to Rainier avenue, and on Fifth avenue south from King street to Dearborn street.

ASTORIA, ORE.—In open competition with the steam line of the Spokane, Portland & Seattle Railway between Astoria and Seaside, the jitney has won. Four local trains on the rail line will be taken off because passengers have left the day coaches for the automobiles. This is probably the first case in Oregon where the jitney has stopped trains.

FRESNO, CAL.—The Fresno Interurban Railway Company, which operates cars from J. and Merced streets to the Academy road above Sanger, has been turned from the construction department over to the operating department. P. N. McCaffrey, construction superintendent for the Mahoney Bros., owners and builders of the line, will be succeeded by W. F. Fuller, formerly superintendent for the Stockton Terminal and Eastern, which operates from Stockton to Linden.

TELEPHONE AND TELEGRAPH.

POMONA, CAL.—The Pomona Valley Telephone Union has closed negotiations which will be followed by the erection of a two-story fire proof building at Third and Louisa streets.

FILLMORE, CAL.—The Pacific Telephone & Telegraph Company is making good its promise for a new system for Fillmore. Work of installing a new switchboard, which is the first unit of the new system, has been started. B. L. Skaggs is in charge of the work.

LONG BEACH, CAL.—The Pacific Telephone and Telegraph Company is making improvements here costing $26,050, according to the local manager. The work includes the construction of 1300 ft. 8 duct conduit and 14,000 ft. of 600 pair 22 gauge cable on Fifth street between Linden and Alamito avenues, and an aerial cable on Fifth street, between Orange and Fourth street.

IMPERIAL, CAL.—Word from the El Centro Chamber of Commerce is being awaited by officials of the Imperial Telephone Company before ordering the construction of some 50 miles of line between Dixieland and Mt. Springs. The telephone company has had estimates of the cost of line made and has submitted a proposition to the Chamber of Commerce, whereby the line may be maintained partly by the chamber and partly by charges to patrons.

IRRIGATION.

TWIN BRIDGES, MONT.—M. S. Gould was low bidder for construction of a municipal water system at $28,856.50.

VALE, ORE.—The Warm Springs Irrigation District has voted $750,000 in bonds for the construction of a dam and improvements to its distribution system.

VANCOUVER, WASH.—The county commissioners have granted permission to the North Coast Power Company to lay large water mains along the river road east of Vancouver.

WILLOWS, CAL.—The petition for the formation of the Princeton-Cordora-Glenn Irrigation District will be presented to the Glenn County Board of Supervisors on September 5.

NORTH YAKIMA, WASH.—The U. S. Reclamation Service has purchased the John Russell ranch, on the Upper Tieton, as a part of the storage basin of the Clear Creek dam at McAllisters Meadows.

EVERETT, WASH.—Articles of incorporation were filed by Washington Coast Utilities Company, with capital fixed at $100,000. The new concern will supply gas, water, electricity to towns in vicinity of Arlington.

LINDSAY, CAL.—The directors of the Lindsay-Strathmore Irrigation District has voted to award the contract for the construction of the proposed Lindsay Irrigation System to James Kennedy of Los Angeles, his bid being $1,231,240.

PORT TOWNSEND, WASH.—City Engineer Sadler and his survey crew have made a survey of a route for the proposed extension of the supply for the Olympia gravity water system, and the data and estimates will be presented to the council at an early date.

EL PASO, TEX.—Water of the Rio Grande will be started through the Electric Butte dam on October 14th. This giant impounding dam forms the largest irrigation reservoir in the world. More than 45 miles in length and eight miles across, the lake stores the melted snows of the Colorado mountains.

HONCUT, CAL.—The project looking to the irrigation of the foothill lands east and northeast of Honcut is progressing favorably. It is estimated at the outset that 10,000 acres would insure the success of the enterprise. This project contemplates taking over the South Yuba system of ditches, enlarging them and adding to their capacity.

DIXON, CAL.—It is stated northern Solano will have an irrigation system in less than two years. The source of water is said to be Cache Creek and Prospect Slough in the vicinity of Maine Prairie with the main ditch running southwest of Dixon towards Winter, Yolo county, which would require one of two lifts operated by powerful pumps.

PORTLAND, ORE.—A water power plant capable of developing about 18,000 horsepower, sufficient to care for all street lighting in Portland for many years to come, is possible on the Sandy and Zig Zag rivers, near Mount Hood, within the Oregon forest reserve, according to preliminary investigations made by the engineers of the water bureau.

RENO, NEV.—Surveyors have practically completed their work at Pyramid Lake, preparatory to the construction of a permanent dam for an irrigation project on the Indian reservoir. An appropriation of $30,000 was made last year to start the work and supplies and material for the dam have been ordered. The project calls for the expenditure of $85,000.

WOODLAND, CAL.—The trustees of Reclamation District 1600 have awarded the contract for installing the big pumping plant to the Yuba Construction Company at $23,147. The plans necessitate the installation of three pumps. The Westinghouse Electric Company was awarded the contract for furnishing two 250 h.p. motors. The Pacific Gas & Electric Company will furnish the power for a term of five years at $5930.

SALT LAKE, UTAH.—The Lewiston Bear Lake Irrigation Company has awarded the Salt Lake Hardware Company the contract for the installation of four large Allis-Chalmers pumping units of 45,000 gallons per minute. These units will be installed on Bear River about two miles west of Fairview, Idaho. The entire installation, including pumping station, diversion canal and pipe line, will involve an expenditure close to $70,000.

FORT JONES, CAL.—Farmers of Scott Valley are considering the report of a committee on the law governing irrigation districts. It is proposed to take water from Scott River on the ranch owned by J. J. Fay and convey it in ditch along the east side of Scott Valley to the C. S. Hammond ranch. About 10,000 acres will be covered by the proposed system, which the engineer estimates will cost $100,000. About one-half of the project is upland soil.

SACRAMENTO, CAL.—The Carmichael Colony Irrigation District sold $67,600 of the $90,000 bond issue needed to construct the irrigation plant at what is said to be the highest price ever received in California for the original issue of any district. The first $22,000 brought par and the remainder sold at $97.17. The bonds bear 6 per cent interest. Work on the project will commence immediately. It was at first thought $90,000 would be needed to complete the district, but it was found that because of the great amount of work already perfected by owners, $57,600 would be ample. Every ten-acre tract in the district will be provided ample water for irrigation purposes.

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Cord, Lamp Cotton Covered, per 1000.	List.	Sell.
12	$ 85.00	$ 85.00
14	60.00	60.00
16	40.00	40.00
18	32.00	32.00
18 single conductor	22.00	22.00
Cord, Lamp. Silk Covered, Per 1000.		
12	90.00	90.00
14	70.00	70.00
16	60.00	60.00
18 single conductor	40.00	40.00
Cord—Duplex. Silk Covered, Per 1000.		
12	150.00	150.00
14	125.00	125.00
16	90.00	90.00
18	75.00	75.00
Cord, Reinforced Lamp. Cotton Covered, Per 1000.		
12	125.00	125.00
14	100.00	100.00
16	75.00	75.00
18	70.00	70.00
Cord Steel Armored, Flexible.		
18 E.	100.00	100.00
16 E.	120.00	120.00
14 E.	175.00	175.00
Cord Steel Armored, Flexible. Reinforced.		
18 EM.	160.00	160.00
16 EM.	185.00	185.00
14 EM.	250.00	250.00
Cord Brewery, Per 1000.		
12	75.00	75.00
14	60.00	60.00
16	50.00	50.00
18	40.00	40.00
Cord Packing House, Per 1000.		
12	90.00	90.00
14	80.00	80.00
16	70.00	70.00
18	60.00	60.00
Cord Asbestos Heater, Per 1000.		
10	175.00	175.00
12	150.00	150.00
14	120.00	120.00
16	100.00	100.00
18	100.00	100.00

The correctness of these suggested selling prices is not guaranteed by the publisher. Suggestions for corrections are invited.

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Cut-Outs—Each. Plug—125-250V. Cartridge—250 V.	List.	Sell.
No. 1917 0- 30 Amps. D. P. Main	.55	.55
No. 1918 31- 60 Amps. D. P. Main	1.40	1.40
No. 271 61-100 Amps. D. P. Main	2.80	2.80
No. 1919 0- 30 Amps. D. P. Single Branch	.70	.70
No. 1920 31- 60 Amps. D. P. Single Branch	1.75	1.75
No. 1921 0- 30 Amps. D. P. S. or D Branch	.65	.65
No. 1922 0- 30 Amps. D. P. D. B	1.30	1.30
No. 1996 31- 60 Amps. D. P. D. B	3.50	3.50
No. 1923 0- 30 Amps. 3.2 wire D. B	1.50	1.50
No. 1997 31- 60 Amps. 3-2 Wire D. B	4.20	4.20
No. 1924 0- 30 Amps. 3P Main	.80	.80
No. 1925 31- 60 Amps. 3P Main	2.00	2.00
No. 272 61-100 Amps. 3P Main	4.00	4.00
No. 1926. 0 -30 Amps. 3P S. P.	1.35	1.35
No. 1927 31- 60 Amps. 3P S. B.	3.00	3.00
No. 1928 0- 30 Amps. 3P D. B.	2.25	2.25
No. 1998 31- 60 Amps. 3P D. B.	6.00	6.00
No. 1929 0- 30 Amps. Single P. Porc. Base.	.40	.40
No. 1930 31- 60 Amps. Single P. Porc. Base.	.65	.65
No. 1931 61-100 Amps. Single P. Porc. Base.	1.40	1.40
No. 1932 101-200 Amps. Single P. Porc. Base.	2.75	2.75
No. 1933 61-100 Amps. S. P. Slate Base	.90	.90
No. 1934 101-200 Amps. S. P. Slate Base	2.10	2.10
No. 1935 201-400 Amps. S. P. Slate Base	5.25	5.25
No. 1936 401-600 Amps. S. P. Slate Base	7.20	7.20
600 V.		
No. 1937 0- 30 Amps. S. P. Porc. Base	.60	.60
No. 1938 31- 60 Amps. S. P. Porc. Base	.90	.90
No. 1939 61-100 Amps. S. P. Porc. Base	1.75	1.75
No. 1940 101-200 Amps. S. P. Porc. Base	3.00	3.00
No. 1941 61-100 Amps. S. P. Slate Base	1.32	1.32
No. 1942 101-200 Amps. S. P. Slate Base	2.30	2.30
No. 1943 201-400 Amps. S. P. Slate Base	6.00	6.00
No. 1944 401-600 Amps. S. P. Slate Base	7.80	7.80
Cut-Outs—Plug. 125-250 V.		
No. 62569 S. P. Main line	.20	.18
No. 62965 D. P. Main line	.30	.30
No. 8020 D. P. Branch S. or D	.35	.36
No. 61935 D. P. S. B	.30	.32
No. 8042 3-wire S. B	.55	.54
No. 62587 D. P. D. B	.60	.62
No. 62165 3-wire main line	.45	.44
No. 62135 3-wire D. B	.90	.90
No. 62199 3 to 2 wire D. B	.64	.64
Electric Door Opener		
Electric door opener	3.00	3.00
Extension Cords.		
6 ft., complete with socket and plug	.80	.80
8 ft., complete with socket and plug	.85	.85
10 ft., complete with socket and plug	.90	.90

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ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page following

A-1 American Ever-Ready Works of National Carbon Co.. 6
Los Angeles; 755 Folsom St., San Francisco; Seattle.

B-1 Baker-Joslyn Company..... 3
71 New Montgomery St., San Francisco; 911 Western Ave., Seattle; 353 E. Second St., Los Angeles.

B-2 Benjamin Electric Manufacturing Co..... 5
590 Howard St., San Francisco.

C-1 Century Electric Co..... 4
906 So. Hope St., Los Angeles; 56 Natoma St., San Francisco; 65 Front St., Portland, Ore.

C-3 Crocker-Wheeler Co..... 3
87 New Montgomery St., San Francisco; 228 Central Avenue, Los Angeles.

C-4 Cutler-Hammer Manufacturing Co.....
579 Howard St., San Francisco; Morgan Bldg., Portland, Ore.; San Fernando Bldg., Los Angeles.

D-4 Davis Slate & Manufacturing Co.....
Chicago, Ill.

D-2 Dearborn Drug and Chemical Works..... 11
355 East Second St., Los Angeles; 301 Front St., San Francisco.

E-1 Edison Lamp Works of General Electric Co.....
Rialto Bldg., San Francisco; 724 So. Spring St., Los Angeles.

E-2 Edison Storage Battery Supply Co..... 11
441 Golden Gate Ave., San Francisco.

E-3 Electric Agencies Co.....
247 Minna Street, San Francisco; Central Building, Los Angeles.

E-4 Electric Storage Battery Co..... 3
743 Rialto Bldg., San Francisco.

E-5 Electric, Railway & Manufacturing Supply Co..... 11
34 Second St., San Francisco.

E-6 Electric Novelty Works.....
533 Mission St., San Francisco.

E-7 Economy Fuse & Mfg. Co.....
Kinzie and Orleans Sts., Chicago.

F-3 Federal Sign System (Electric).....
618 Mission St., San Francisco.

G-1 General Electric Co..... 10
724 So. Spring St., Los Angeles; Worcester Bldg., Portland; Rialto Bldg., San Francisco; Colman Bldg., Seattle; Paulsen Bldg., Spokane.

H-1 Habirshaw Electric Cable Co., Inc.....
(See Western Electric Company.)

H-2 Hemingray Glass Co..... 11
236-240 So. Los Angeles St., Los Angeles; 345 Oak St., Portland; 807 Mission St., San Francisco.

H-3 Haller-Cunningham Electric Co.....
428 Market St., San Francisco.

H-7 Hurley Machine Co.....
New York and Chicago. (See Pacific States Electric Co.

I-2 Illinois Electric Co.....
261-263 So. Los Angeles St., Los Angeles.

I-3 Interstate Electric Novelty Co.....
111 New Montgomery St., San Francisco.

L-1 Leahy Manufacturing Co.....
Eighth and Alameda St., Los Angeles.

L-2 Locke Insulator Manufacturing Co..... 12
(See Pierson, Roeding & Co.)

M-2 McGlauflin Manufacturing Co.....
San Rafael, Cal.

M-3 Moore & Co., Charles C..... 3
Van Nuys Bldg., Los Angeles; Spalding Bldg., Portland; Kearns Bldg., Salt Lake City; Sheldon Bldg., San Francisco; Mutual Life Bldg., Seattle; Santa Rita Hotel Bldg., Tucson.

M-4 Morse Chain Company..... 6
Monadnock Bldg., San Francisco.

N-1 Nason & Co., R. N.....
151 Potrero Ave., San Francisco.

N-2 National Conduit & Cable Co., The.....
Trust and Savings Bldg., Los Angeles; Rialto Bldg., San Francisco.

N-3 National Lamp Works of G. E. Co..... 2
(All Jobbers.)

N-4 New York Insulated Wire Co..... 4
629 Howard St., San Francisco.

N-6 National Carbon Company.....
Cleveland, Ohio.

O-1 Okonite Co. (The)..... 12
(All Jobbers.)

P-2 Pacific States Electric Co..... 2
236-240 So. Los Angeles St., Los Angeles; 61-67 Fifth St. No., Portland; 200-210 Twelfth St., Oakland; 575 Mission St., San Francisco; 307 First Ave. So., Seattle.

P-4 Pelton Water Wheel Co..... 11
2219 Harrison St., San Francisco.

P-5 Pierson, Roeding & Co..... 12
Pacific Electric Bldg., Los Angeles; Rialto Bldg., San Francisco; Colman Bldg., Seattle.

P-7 Pittsburgh Piping & Equipment Co..... 12
Monadnock Bldg., San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The..... 4
211 J St., Sacramento; 356 Market St., San Francisco.

S-4 Southern Pacific Co..... 4
Flood Bldg., San Francisco.

S-5 Sprague Electric Works..... 11
Rialto Bldg., San Francisco; Colman Bldg., Seattle; Corporation Bldg., Los Angeles; Electric Bldg., Portland; Paulsen Bldg., Spokane.

S-6 Standard Underground Cable Co..... 3
First National Bank Bldg., San Francisco; Hibernian Bldg., Los Angeles; Central Bldg., Seattle, Wash.; 815 Newhouse Bldg., Salt Lake City, Utah.

T-1 Thomas & Co., R.....
Pacific States Electric Co. and Western Electric Co., Pacific Coast Representatives.

T-2 Tubular Woven Fabric Company.....
Pawtucket, R. I.

U-1 United Sheet Metal Works.....
575 Howard St., San Francisco.

W-1 Wagner Electric Manufacturing Company.....
St. Louis, Mo.

W-2 Western Electric Co.....
Eighth and Santee Sts., Los Angeles; 1900 Telegraph Ave., Oakland, Cal.; 680 Folsom St., San Francisco; 907 First Ave., Seattle; 45 North Fifth St., Portland, Ore.

W-3 Ward-Leonard Electric Co..... 12
Mt. Vernon, New York.

W-4 Westinghouse Electric and Manufacturing Co.....
50-52 East Broadway, Butte; Van Nuys Bldg., Los Angeles; Couch Bldg., Portland; 212 So. W. Temple, Salt Lake City; 165 Second St., San Francisco; Second and Cherry Sts., Seattle; Paulsen Bldg., Spokane.

W-6 Westinghouse Lamp Co.....
(See Westinghouse Electric & Manufacturing Co.)

W-8 Western Pipe & Steel Co.....
444 Market St., San Francisco; 1758 North Broadway, Los Angeles